TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Merritt Timber Supply Area Analysis Report

March 2001

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Merritt Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and a socio-economic analysis and is part of the provincial Timber Supply Review carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia. A review of each TSA and TFL is completed at least once every five years.

To determine allowable timber harvesting levels accurately and rationally, the chief forester must have an up-to-date assessment of the timber supply, based on the best available information and reflecting current management direction. The report that follows provides only this assessment and should not be considered as a recommendation on permissible harvest levels.

This report focuses on a single forest management scenario — current management practices. Current management practices are defined by the specifications in management plans for the timber supply area including guidelines for the protection of forest resources, the *Forest Practices Code (FPC)* and official land-use decisions made by Cabinet.

Assessing the implications of only current practices rather than looking at a number of different management regimes expedites the analysis process, allowing analysis of all TSAs in the province every five years. An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply provide a basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC) the chief forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the chief forester with some of the information necessary for these considerations.

The socio-economic analysis considers forestry activity associated with the harvesting and processing of timber harvested from the TSA within the context of regional timber supply and production capacity.

This report is the third of five documents that will be released for each TSA as part of the Timber Supply Review. (The first two documents are the information report and the data package.) This document provides technical information on the results of the timber supply and socio-economic analyses. A separate document called the public discussion paper will summarize the technical information and will provide a focus for public discussions of possible timber harvest levels. The fifth will outline the chief forester's harvest level decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Merritt Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over both the short (next 20 years) and long (next 250 years) terms. It also examines the potential changes in timber supply resulting from uncertainties about forest growth and management actions. **The various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Merritt TSA is located in the south-central interior of British Columbia, primarily in the Interior Douglas-fir, Montane spruce, and Englemann spruce-subalpine fir biogeoclimatic zones. It covers an area of approximately 1.13 million hectares within the Kamloops Forest Region. Of this total area, approximately 660 326 hectares are considered available for timber production and harvesting under current forest management practices. These practices follow the standards and legislation set out by the *Forest Practices Code* and various agreements and plans which guide current operational management. Within the area available for timber harvesting, most of the forests are dominated by lodgepole pine, although there are also significant areas dominated by Douglas-fir, spruce, and balsam.

The results of this timber supply analysis suggest that, after taking into consideration the current AAC (1 995 550 cubic metres, which includes an uplift for fire and mountain pine beetle salvage and is adjusted to account for 8700 cubic metres attributable to woodlots), the pre-uplift AAC (1 445 550, adjusted for woodlots) can be maintained for six decades. This level can be maintained without creating future timber supply disruptions, if followed by a controlled reduction over the subsequent three decades to 1.12 million cubic metres per year, which can be sustained for the remainder of the 250-year planning horizon. This result reflects current knowledge and information on forest inventory, growth, and management. However, it is important to recognize that uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses show that these uncertainties can affect timber supply to varying degrees.

None of the changes to assumptions used in the sensitivity analyses resulted in a disruption of short-term timber supply. Because of the abundance of timber of harvestable age, changes in analysis inputs related to inventory, growth and yield, and management only affected either the timing of the decline to the long-term harvest level, the long-term harvest level itself, or both.

Medium- and long-term timber supply is significantly affected by changes to the timber harvesting land base, such as the removal of proposed protected areas or the exclusion of Douglas-fir stands from the timber harvesting land base. Uncertainty about estimates of site productivity for old-growth stands and smallwood pine stands, and the rule used to set harvest priority can also have a significant impact on both the medium- and long-term.

Uncertainty associated with estimates of existing unmanaged stand volumes significantly affects medium-term timber supply; if these volumes are underestimated by 10%, the decline to the long-term harvest level can be delayed by four decades. If these volumes are overestimated by 10%, then the decline to the long-term harvest level must occur five decades sooner than in the base case.

Long-term harvest levels are significantly sensitive to changes in managed stand volume estimates. Uncertainty about managed stand volume estimates has a proportionate effect on the long-term harvest level. In other words, if managed stand volumes are underestimated by 10%, the long-term harvest would be 10% higher than in the base case.

Other areas of uncertainty examined had a very small impact on timber supply. These include uncertainty about: green-up ages, minimum harvestable ages (MHA); landscape-level biodiversity requirements, standard management green-up requirments, and the priority for harvest of pine stands relative to other species. For these areas of uncertainty and the levels of uncertainty examined in this analysis, timber supply impacts did not exceed 5% of the long-term harvest level, and only affected the decline to the long-term harvest level by a maximum of one decade.

Executive Summary

The socio-economic analysis for the Merritt TSA indicates that based on volumes billed, the average harvest level for 1996–1999 was 1 424 218 cubic metres per year. This harvest level supported about 1,274 person-years of direct employment and about 1,733 person-years of indirect and induced employment across the province.

The base case harvest forecast suggests that the pre-uplift AAC level of 1 445 550 cubic metres per year, which excludes both the uplift of 550 000 cubic metres and a volume of 8700 cubic metres for issued woodlot licences, can be maintained for the next six decades.

If fully harvested and utilized, the base case harvest level could support about 1,293 person-years of direct employment and about 1,759 person-years of indirect and induced employment across the province, a small increase over the 1996-1999 levels. Harvests at the base case level are projected to generate about $51.3 million per year in provincial government revenues.

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Introduction

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth pattern. Decisions about whether a stand is available for harvest often depend on how its harvest could affect other forest values, such as wildlife or recreation.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is a subject of ongoing debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood.

Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the chief forester of British Columbia in determining an allowable annual cut (AAC)*.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* requires that the timber supply for management units throughout British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 of the Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data. The B.C. Forest Service forest inventory* plays a major role in this. The second step is using this data along with a timber supply computer model or models to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions that describe the forest and forest management. The third step is interpreting and reporting results.

Sections 1 through 6 outline the timber supply analysis for the Merritt TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Timber supply analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by a summary and conclusions for the timber supply analysis. Appendix A contains further details about the data and assumptions used in the analysis.

As part of the timber supply review (TSR), information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities, requirements and employment levels of existing and proposed processing facilities. The socio-economic analysis is presented in Section 7, and provides information for the chief forester and the local community on the potential magnitude of impacts associated with any proposed harvest level changes. Appendix B contains more detailed information and discusses some of the limitations of the socio-economic analysis.

Forest inventory
An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

1 Description of the Merritt Timber Supply Area

The Merritt Timber Supply Area (TSA) is located in the south-central interior of the province and covers approximately 1.13 million hectares of the Kamloops Forest Region. The TSA boundaries are similar to those of the Merritt Forest District, which also includes all or part of several provincial parks. The TSA is administered by the forest district office in Merritt and a field office in Princeton. To the north of the Merritt TSA is the Kamloops TSA, to the west are the Lillooet and Fraser TSAs, and to the East is the Okanagan TSA. To the south is Manning Park, Cathedral Park and the Canada-U.S.A. border.

The Merritt TSA includes the mountainous terrain and steep river valleys of the Cascade Mountains in the west and the relatively dry, flat Thompson Plateau in the east. The TSA encompasses two major river systems, the Similkameen in the south and the Nicola in the north. Lodgepole pine is by far the most common tree species; pine stands cover approximately two-thirds of the timber harvesting land base*. Other common tree species include Douglas-fir, spruce, ponderosa pine, trembling aspen and subalpine fir. Less common species include western redcedar, hemlock, and western larch.

Almost three-quarters of the Merritt TSA land base is considered productive Crown forest land (approximately 811 000 hectares). This TSA is generally considered to be highly operable from a timber harvesting perspective. Currently about 80% of the productive forest is considered available for timber harvesting, representing about 58% of the total TSA land base.

In January 1996, the chief forester established an allowable annual cut (AAC) in the Merritt TSA of 1 454 250 cubic metres. This included a partition* of 250 000 cubic metres per year for small-diameter pine stands, often called "smallwood." In January 1999, the current AAC of 2 004 250 cubic metres was established, providing an additional 550 000 cubic metres per year that was partitioned to stands requiring harvesting to meet fire salvage and forest health objectives. The AAC is apportioned by the Minister of Forests to various licences and includes 8700 cubic metres apportioned to the woodlot licence* program.

Significant changes in forest management legislation, policy and practices have occurred since the last timber supply review was completed. These include: implementation of the *Forest Practices Code**; use of new inventory information on operability* and area occupied by roads; new definitions of problem forest types; and the elimination of backlog not satisfactorily restocked (NSR)* areas. As a result of these and other changes, the analyses presented in this timber supply review are not directly comparable to the previous one.

Timber harvesting land base
Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.
Partition
A portion of the AAC that is attributable to certain types of timber and/or terrain.
Woodlot licence
An agreement entered into under the Forest Act. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Not satisfactorily restocked (NSR) areas
An area not covered by a sufficient number of well spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

1 Description of the Merritt Timber Supply Area

The Merritt TSA is a sparsely populated area with several small communities. The major population centres are Merritt and Princeton, where about 60% of the TSA's population resides. Other smaller communities include Tulameen, Brookmere, Missezula Lake, Douglas Lake, Lower Nicola, Osprey Lake and Allison Lake.

Numerous natural resources are associated with the forest land base in the Merritt TSA. These include forest products, forage, minerals, fish, wildlife, and recreation and tourism opportunities. Extensive grassland and forested areas (including recently harvested areas) provide forage vegetation for both livestock and wildlife. Parks, recreation sites and trails, and roaded and non-roaded areas provide opportunities for numerous outdoor activities, including hiking, fishing, mountain-biking, camping, boating, cross-country skiing and snowmobiling. Recreation visits within the Merritt TSA have increased substantially since the completion of the Coquihalla highway in 1986 and the Okanagan connector in 1990. Provincial parks within the TSA include Monck, Otter Lake, Kentucky-Alleyne, Allison Lake, Bromley, Coldwater and Stemwinder parks. Popular recreation areas in the vicinity include the Coquihalla Summit, Cascade Recreation Area, Manning Park and Cathedral Park.

1 Description of the Merritt Timber Supply Area

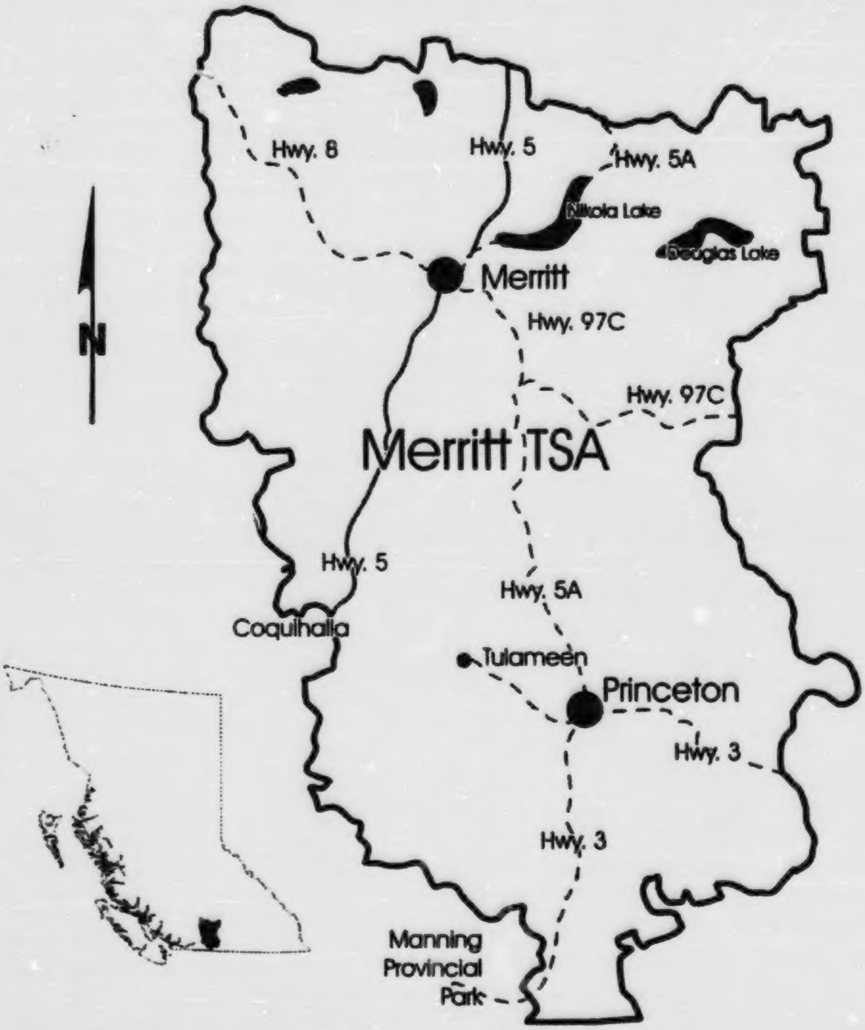

Hwy. 8
Hwy. 5
Hwy. 5A
Nikola Lake
Douglas Lake
N
Merritt
Hwy. 97C
Hwy. 97C
Merritt TSA
Hwy. 5
Coquihalla
Hwy. 5A
Tulameen
Princeton
Hwy. 3
Hwy. 3
Manning
Provincial
Park

Figure 1. Map of the Merritt Timber Supply Area, Kamloops Forest Region.

1 Description of the Merritt Timber Supply Area

1.1 The environment

The climate of the Merritt TSA is variable and includes arid, hot lowlands, cold alpine areas and more humid-temperate coastal transition areas. The TSA contains eight biogeoclimatic zones* that reflect unique combinations of climate, vegetation and soils. The six major ones are described below.

The Bunchgrass (BG) zone has limited occurrence at the lowest elevations of the Nicola river valley. This zone is characterized by warm to hot, dry summers and moderately cold winters with relatively little snowfall. Tree establishment is restricted and grasslands predominate. Although not significant as a source of harvestable timber, the BG zone is important for agriculture, ranching and biodiversity*. The BG zone is one of the smallest in B.C., but it supports a wide range of wildlife, including many species that are of provincial or national significance because of their rarity or uniqueness.

The Ponderosa Pine (PP) zone occupies low elevations along the very dry valleys of the rivers in the Merritt TSA. This zone is characterized by low annual precipitation, very warm summers and cool winters. Open, park-like stands of ponderosa pine and Douglas-fir with a grassy understory dominate the PP zone, making it of limited commercial value for forestry. However it is used for cattle grazing particularly in early spring and late fall.

The Interior Douglas-fir (IDF) zone is the most common zone in the Merritt TSA. It occupies 41% of the TSA and dominates lower to middle elevations, generally above the PP zone and below the Montane Spruce zone. The IDF zone has warm, dry summers and cool winters, allowing a long growing season. Douglas-fir and lodgepole pine are the most common tree species, with ponderosa pine and spruce also occurring. Forestry is a very important resource use in this zone, as is cattle grazing. Wildlife values are also high.

The Montane Spruce (MS) zone is the second most common zone in the Merritt TSA, occupying about 27% of the area. It occurs at middle elevations, generally above the IDF zone and below the Engelmann Spruce-Subalpine Fir zone. The climate of this zone is continental, with cold winters and moderately short, warm summers. The dominant tree species are lodgepole pine, hybrid spruce, subalpine fir and Douglas-fir.

The Engelmann Spruce-Subalpine Fir (ESSF) zone covers about 18% of the Merritt TSA. It is the uppermost forested zone, typically occurring above the MS zone and below the Alpine Tundra zone. The ESSF has a relatively cold, moist and snowy continental climate. Growing seasons are cool and short, while winters are long and cold. Engelmann spruce and subalpine fir are the dominant climax tree species, while lodgepole pine is also common in certain areas.

The Alpine Tundra (AT) zone occurs on only a few high ridges in the Merritt TSA, above the ESSF zone. The climate is cold, windy and snowy with a short, cool growing season. This zone is mostly treeless and vegetation is dominated by shrubs, herbs, mosses and lichens. Much of the alpine landscape lacks vegetation and is the domain of rock, ice and snow.

Very small areas of two other biogeoclimatic zones—the Coastal Western Hemlock (CWH) and the Mountain Hemlock (MH)—overlap with the Merritt TSA.

The diverse landscapes of the Merritt TSA provide a variety of wildlife habitats, including grasslands, lakes and wetlands, forested slopes, and alpine areas. At lower elevations, a greater number of species are present. Common large mammals include mule deer, moose and black bears. Smaller furbearers such as snowshoe hares, pine marten and ground squirrels are also common. Numerous bird and amphibian species occur in the TSA. Grizzly bears also occur within the TSA and although their population is low, the Merritt TSA is part of the Canada/USA North Cascades grizzly bear population unit and may be subject to future recovery planning efforts. The TSA has numerous rivers, lakes and streams that support many species of non-sport fish and sport fish such as rainbow trout, kokanee, burbot, mountain whitefish, eastern brook trout, bull trout and steelhead. Coho, chinook and pink salmon also spawn within the Nicola River.

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

1 Description of the Merritt Timber Supply Area

Under the *Forest Practices Code*, a process exists for identifying species at risk and designating wildlife habitat areas with specific management practices. Within Volume 1 of the *Identified Wildlife Management Strategy*, 19 species have been identified as occurring within the five ecosections of the Merritt Forest District. These species are presented in Table 1. The Southern Thompson Upland ecosection is by far the dominant one in this TSA.

Table 1. Species at risk listed under the Forest Practices Code that inhabit the Merritt TSA.

Common names of identified wildlife	Ecosection				
	Leeward Pacific ranges	**Pavilion ranges**	**Hozameen range**	**Okanagan ranges**	**Southern Thompson Upland**
Bull trout	x	x	x		x
Tailed frog	x	x	x	x	x
Rubber boa	x	x	x	x	x
Racer	x	x		x	x
Gopher snake *deserticola*		x		x	x
American bittern				x	x
Northern goshawk *atricapillus*	x	x	x	x	x
Ferruginous hawk				x	x
Prairie falcon		x		x	x
Long-billed curlew				x	x
Lewis's woodpecker				x	x
White-headed woodpecker				x	x
Yellow-breasted chat				x	
Boblink					x
Mountain beaver *rainieri*	x		x	x	x
Fisher	x	x		x	
Grizzly bear	x	x			
Mountain goat	x	x			x
Bighorn sheep *californiana*				x	x

Source: Managing Identified Wildlife: Procedures and Measures Volume 1, February 1999.

Protection of water quality and quantity is an important management objective in this TSA. Significant demands are placed on water resources for domestic and agricultural purposes, as well as maintenance of fisheries values and aquatic ecosystems. There are currently 10 community watersheds* within the Merritt TSA.

Current forest management practices follow the legislation set out by the *Forest Practices Code*. Consequently, the protection of many non-timber resources and values is in accordance with the *Code*.

1.2 First Nations

The Nlaka'pamux Nation and the Okanagan Nation have traditional territories within the Merritt TSA. Currently, six First Nation communities are located in the TSA with a combined population of about 2,360 people. These are the Coldwater Band, Lower Nicola Band, Nooaitch Band, Shackan Band, Upper Nicola Band and Upper Similkameen Band. Four other First Nations communities located outside the TSA have reserves and traditional interests within the TSA. These bands are the Westbank Band (Westbank), Lower Similkameen Band (Keremeos), Nicomen Band (near Spences Bridge) and Cook's Ferry Band (Spences Bridge).

The Westbank Band is the only band with interests in the Merritt TSA that is currently in formal negotiations under the provincial Treaty process.

Some First Nations have expressed concerns regarding possible harvesting impacts on ethno-botanical forest resources and areas of cultural and spiritual importance, as well as on fisheries and wildlife resources. More recently, some bands have questioned the impacts of stand tending practices on small furbearing mammals.

Nineteen First Nations have expressed interest in securing wood supply and several are actively participating in the forest industry. Eight bands currently hold woodlots in the Merritt Forest District, and First Nations have membership on the Nicola-Similkameen Innovative Forestry Society.

No archaeological overview assessment has been completed for the Merritt TSA but archaeological inventory studies have been undertaken. A traditional use study is currently underway for the Nicola watershed.

Numerous archaeological sites exist within the Merritt TSA and archaeological impact assessments are normally undertaken if recommended by an archaeologist as part of forest development planning.

Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.

2 Information Preparation for the Timber Supply Analysis

The following sections provide an outline of the information used in the timber supply analysis. This information can be divided into three general categories: land base inventory; timber growth and yield; and management practices.

2.1 Land base inventory

Land base information used in this analysis came in the form of a computer file compiled by the Ministry of Forests, Merritt Forest District in 1999. This file contains information on the forest land in the Merritt TSA including the geographic location, area, nature of the forest cover (such as presence or absence of trees; species, number and age of trees; and timber volume), and other characteristics such as environmental sensitivity, and physical accessibility (operability). Stand characteristics such as tree height, stocking* and age have been projected to 1998/99. Also, the file has been updated to account for timber harvesting up to 1998/99. The file was adjusted prior to the analysis to account for the effect of the Lawless Creek wildfire that occurred in 1998, as described below in Appendix A (Section A.4.7, "Lawless Creek wildfire").

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and on areas where timber harvesting is not expected to occur. Examples are lands set aside for parks, areas needed to protect wildlife habitat, areas in utility and transportation corridors, and residential and industrial development. A general description of these areas in the Merritt TSA is provided below. These types of areas do not contribute to the timber harvesting land base of the Merritt TSA. Before assessing timber supply, these non-contributing areas are identified and separated from the timber harvesting land base.

Identifying areas not contributing to timber supply does not mean the area is removed from the TSA. The B.C. Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

This section describes the types of areas that do not contribute to the timber harvesting land base. Use of the term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain timber of sufficient economic value, and sites of adequate environmental resilience, to accommodate timber harvesting with due care for other resources.

For the Merritt TSA, the following types of areas were excluded from the timber harvesting land base.

- not managed by the B.C. Forest Service — these are non-Crown areas (such as private land and Federal reserves) and parks which are removed from the TSA. The forested portions of parks and ecological reserves contribute towards biodiversity.
- woodlot licences (WLs) — AACs and management in woodlot licences are administered separately from the rest of the TSA. Therefore, they are excluded from the TSA timber harvesting land base.
- non-forested and non-productive forested areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies). Some of the non-productive forested areas occupied by trees with low growth potential contribute toward visual quality objectives (VQO)*.

Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

Visual quality objective (VQO)
Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.

- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- environmentally sensitive areas* — all areas with high environmental sensitivity or with highly significant wildlife or recreation values are excluded from the timber harvesting land base.
- inoperable areas* — area that are not harvestable due to very steep slopes, unstable soils or other terrain-related or economic reasons.
- problem forest types — stands which are physically operable yet are not currently utilized because they are not merchantable, or have low timber growing potential. All deciduous* stands are included in this category.
- cultural heritage resources* — a 50-metre no-harvest buffer has been applied to all areas identified as archaeological sites.
- riparian areas* — areas assumed to be unavailable for harvesting to provide protection for riparian and stream ecosystems.
- Hudson's Bay trail — a 100-metre no-harvest buffer has been applied to either side of the designated portion of the Hudson's Bay trail.
- water intakes for community watersheds — no harvesting may occur within 100-metres above community watershed water intakes.
- existing roads, trails, and landings — areas of forest land that have been removed from timber production due to access development and harvesting to date.
- wildlife tree* patches (WTP) — areas reserved within and along the edges of cutblocks* for the maintenance of stand-level biodiversity* (stand structure), primarily for conservation or enhancement of wildlife.
- grassland to forest transition areas — areas currently in grassland/forest transition that will be harvested once to convert fully to grasslands.

Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, or impediments to establishing a new tree crop, or areas where timber harvesting may cause avalanches.
Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.
Deciduous
Deciduous trees commonly have broad-leaves and usually shed their leaves annually.

Cultural heritage resource
An object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community or an aboriginal people.
Riparian area
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Cutblock
A specific area, with defined boundaries, authorized for harvest.
Stand-level biodiversity
A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.

2 Information Preparation for the Timber Supply Analysis

A more detailed description of these categories, including specific criteria for removal is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category, and shows the area of the timber harvesting land base. The column "Crown productive forest area by classification" provides the total area within the given category. For example, while a total of 34 405 hectares of Crown productive forest is covered by problem forest types, only 22 856 hectares were removed specifically for problem forest types. The difference arises because one area can be in more than one classification (e.g., ESA, inoperable, and problem forest type). Problem forest types would constitute a larger proportion of the reduction if they were considered prior to these other land classifications. Because of the overlap among land classification categories, the actual area deducted to arrive at the timber harvesting land base depends on when the reduction occurs in the sequence.

Table 2. Timber harvesting land base for the Merritt TSA

Land classification	Crown productive forest area by classification (hectares)	Area (hectares)	Per cent of total TSA area	Per cent of Crown forest land
Total TSA area		**1 130 064**	100.0	
Private, Federal, TFL, WL, lease lands		209 456	18.5	
Non-commercial brush, non-forested, and non-productive forest		98 193	8.7	
Parks and ecological reserves		11 017	1.0	
Total forest area managed by the B.C. Forest Service (Crown productive forest)		**811 398**	71.8	100.0
Reductions to Crown productive forest:				
Environmentally sensitive areas (ESA)	34 531	34 531	3.1	4.3
Inoperable areas, steep slopes, difficult terrain	49 901	36 365	3.2	4.5
Problem forest types	34 405	22 856	2.0	2.8
Cultural heritage resources	51	43	0.0	0.0
Riparian areas	36 695	32 111	2.8	4.0
Hudson's Bay trail	495	423	0.0	0.1
Water intakes for community watersheds	7	3	0.0	0.0
Existing roads, trails, and landings	[a]	11 745	1.0	1.4
Wildlife tree patches	[a]	12 995	1.1	1.6
Total reductions to Crown productive forest		151 072	13.4	18.6
Current timber harvesting land base		**660 326**	58.4	81.4
Reduction for grassland/forest transition areas converted to grasslands		1 258	0.1	0.2
Reduction for future roads		38 516	3.4	4.7
Future timber harvesting land base		620 550	54.9	76.5

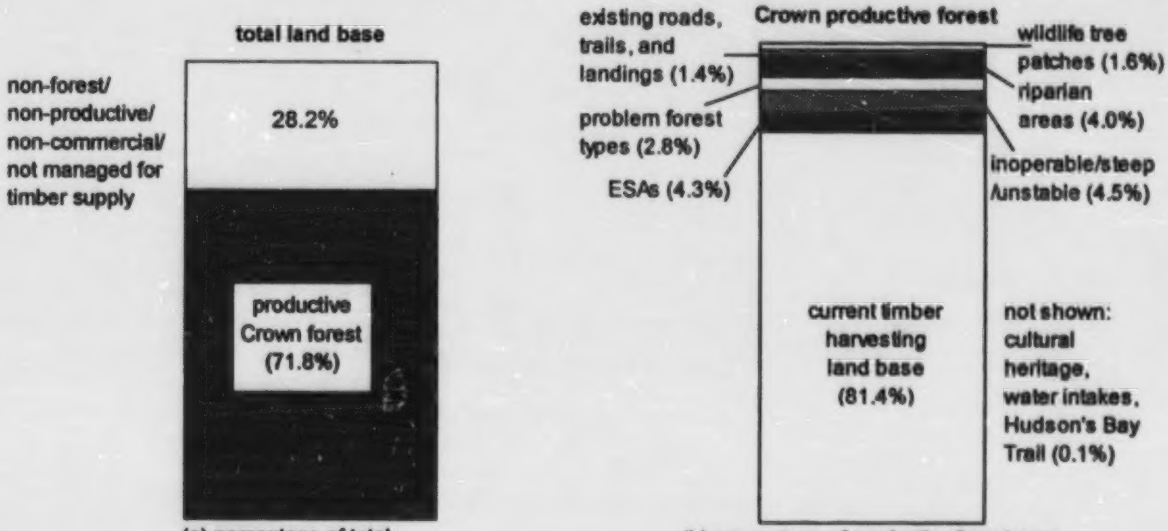
(a) Determined as a percentage of the timber harvesting land base at that point in the land base reductions. See Appendix A.3.12 "Roads, trails and landings" and A.3.13 ,"Wildlife tree patches" for more details.

2 Information Preparation for the Timber Supply Analysis

The total forest area managed by the BCFS (811 398 hectares) less existing roads, trails and landings (RTLs) (11 745 hectares) plus parks and ecological reserves (11 017 hectares) was the area used as a basis for assessing forest cover requirements* for biodiversity, watersheds and wildlife in this analysis (810 670 hectares). For visually sensitive areas, an additional 8717 hectares (non-productive forest found to contain attributes that meet visual quality objectives) was included in the assessment for a total assessment area of 819 387 hectares.

The current timber harvesting land base in the Merritt TSA represents about 58% of the total TSA area and over 80% of the forest area managed by the B.C. Forest Service (Crown productive forest).

Figure 2 represents both the total Merritt TSA area, and the Crown forested land base. The total area chart shows that about 28% of the total land base is classified as not managed for timber supply, or non-forested, non-productive forest, or non-commercial brush. Approximately 72% of the total Merritt TSA is considered Crown productive forest. The Crown productive forest chart details the categories of forest land and shows that about 20% of the Crown productive forest land in the Merritt TSA is currently considered unavailable for harvesting. The categories which most reduce the availability of the Crown forest for timber supply are ESAs, inoperability, and riparian areas, each of which represent approximately 4% of the Crown forest. Approximately 81% of the Crown productive forest is considered available for timber harvesting.



(a) percentage of total

(b) percentage of productive forest area

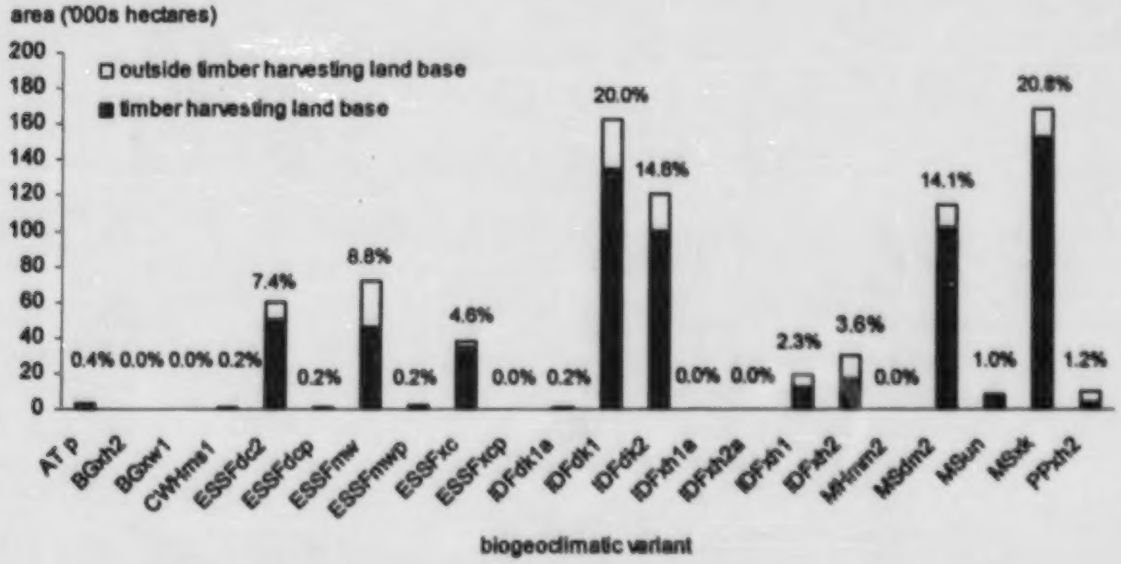
Figure 2. Composition of the total and Crown forested land bases — Merritt TSA, 2001.

Forest cover requirements

Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see Cutblock adjacency guidelines and Green–up).

The current timber harvesting land base is larger by approximately 132 000 hectares (25%) than in the last timber supply analysis. This is mostly due to the inclusion in the timber harvesting land base of some of the stands previously considered unmerchantable to harvest, such as some Douglas-fir stands, spruce and balsam stands and smallwood pine stands. While some smallwood pine stands were ultimately incorporated into the AAC for the Merritt TSA under the partition of 250 000 cubic metres per year, they were not included in the timber harvesting land base in the last timber supply analysis. Additional smaller increases in the timber harvesting land base since the last analysis can be attributed to lower estimated losses due to roads, trails, and landings and the inclusion in the timber harvesting land base of some areas of moderate environmental sensitivity. These increases have been slightly offset by an increase in the amount of inoperable areas, and management for riparian areas and wildlife tree patches under the *Forest Practices Code*. There were no timber harvesting land base exclusions for inoperability and wildlife tree patches in the last timber supply review.

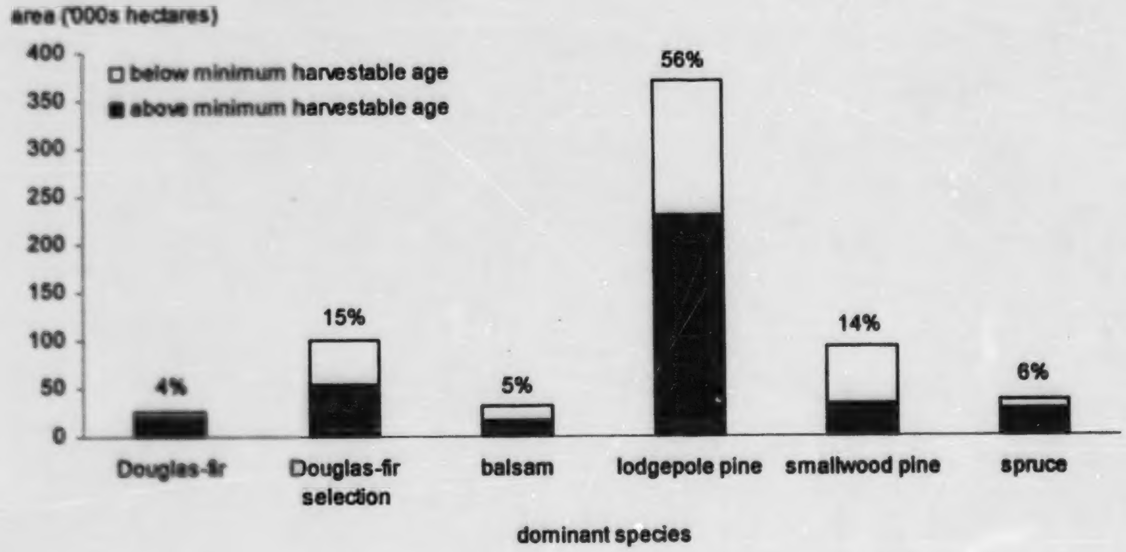
Figure 3 shows overall distribution of biogeoclimatic (BEC) variants in the Crown forested area and the forested portions of provincial parks in the TSA. Also shown is the amount of each BEC variant that is in the timber harvesting land base. For example, the IDFdk1 variant makes up 20% of the Crown forested area and forested portions of parks. Approximately 80% of the total area of IDFdk1 is within the timber harvesting land base.



Percent labels indicate the contribution to the total forested area

Figure 3. Forested area by biogeoclimatic classification — Merritt TSA, 2001.

Figure 4 shows the current composition of the timber harvesting land base by dominant tree species. Stands mainly composed of lodgepole pine trees cover most of the timber harvesting land base (almost 60%). An additional 14% of the timber harvesting land base is covered by smallwood pine stands, which are suppressed stands comprised of relatively short pine trees that have been identified in the forest inventory as being on poor productivity sites. Douglas-fir dominated stands cover almost 20% of the timber harvesting land base, and most of these stands (15% of the timber harvesting land base) are being managed using selection harvesting systems. Spruce- and balsam-dominated stands occupy 6% and 5% of the timber harvesting land base, respectively. After harvest, most stands are expected to regenerate primarily to lodgepole pine, except for stands currently dominated by spruce and balsam trees, which are expected to regenerate primarily to spruce following harvest, and Douglas-fir selection stands, which regenerate mainly to Douglas-fir. The expected composition of regenerated stands is described in detail in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis."



Percent labels indicate the contribution to the timber harvesting land base.

Figure 4. Area by dominant tree species — Merritt TSA timber harvesting land base, 2001.

Figure 4 also shows the proportion of area of each species that is either younger or older than the minimum harvestable age (see Appendix A for details on the minimum harvestable age for each species). In total, about 60% of stands in the timber harvesting land base are at or above the minimum harvestable age. The proportion of stands above the minimum harvestable ages varies by species: 62% of lodgepole pine stands, 36% of smallwood pine stands, 78% of Douglas-fir stands, 54% of Douglas-fir selection managed stands, 56% of balsam stands, and 74% of spruce stands are currently older than the minimum harvestable ages. This figure shows that there is abundant timber old enough to be harvested in the Merritt TSA.

Figure 5 shows the distribution of site productivity of the dominant stand types within the timber harvesting land base. Site productivity is classed as good/medium or poor based on site index*. Over all species, 37% of the timber harvesting land base is classified as having relatively good or medium site productivity. Stands with poor site productivity cover 48% of the timber harvesting land base. The remainder of the timber harvesting land base (15%) is covered by selection management* Douglas-fir stands, which have not been separated into site productivity classes for this analysis. Sites with very poor productivity (site index less than 8 metres for young pine stands, site index less than 10.5 metres for all other young coniferous* stands) are excluded from the timber harvesting land base. Some older stands with poor site quality that are not expected to reach a merchantable condition based on present stand height and density conditions are also excluded from the timber harvesting land base. Appendix A "Description of Data Inputs and Assumptions for the Timber Supply Analysis" contains a more detailed definition of good/medium and poor site productivity for the species groups shown in Figure 5.

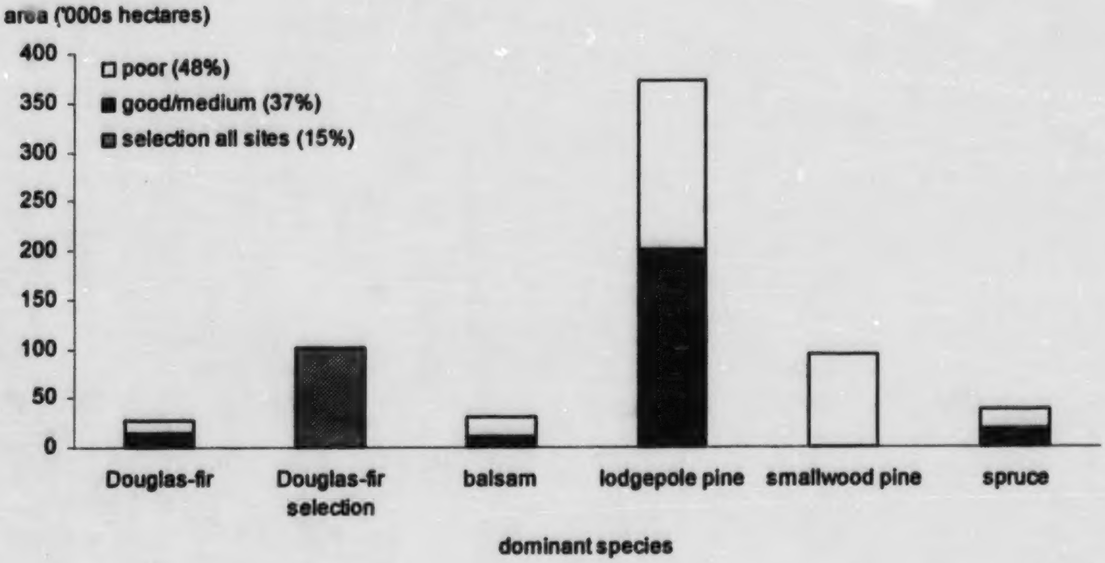


Figure 5. Area by predominant species and site productivity — Merritt TSA timber harvesting land base, 2001.

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

Selection management
A silvicultural system used to maintain or create areas containing a wide range of tree ages or sizes. The time interval between harvests in such areas is fairly short (usually less than 30 years), and during these harvests either single scattered trees or small groups of trees are removed from across the entire area.

Coniferous
Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.

Figure 6 shows the current age composition of all Crown forested area and the forested portions of provincial parks in the Merritt TSA (the 'non-timber harvesting land base'). Currently, few stands either within or outside of the timber harvesting land base are older than 250 years. As indicated above, almost 60% of the stands in the timber harvesting land base are at or above the minimum harvestable age applicable to the stand. Of the stands in the timber harvesting land base, 12% are 20 years of age or younger, 61% are between 21 and 140 years of age, 22% are between 140 and 250 years old, and 4% are 250 years or older.

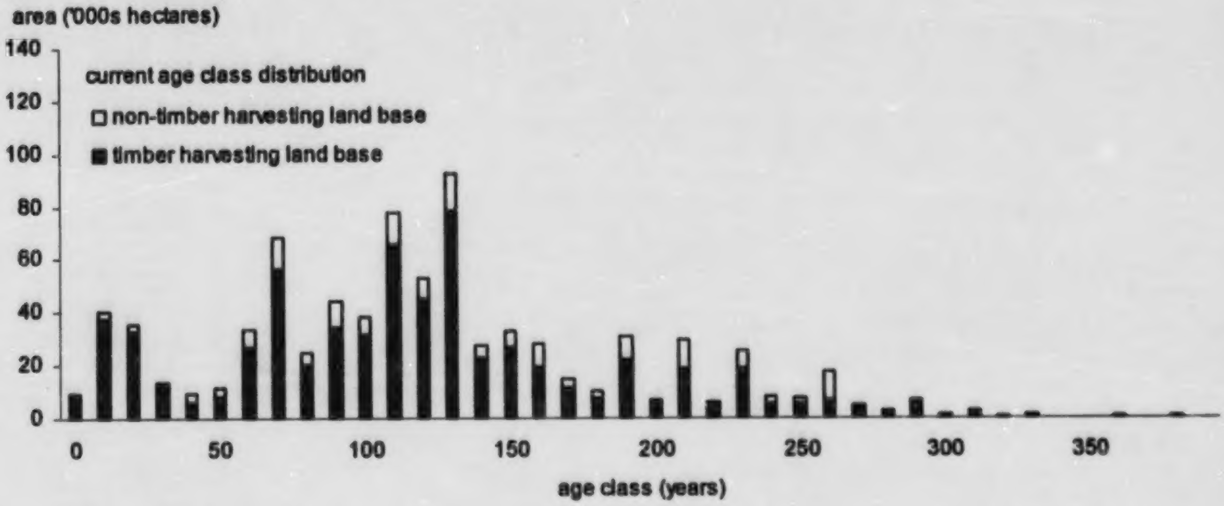


Figure 6. Current age class composition — Merritt TSA forested land base, 2001.

The age class distribution of forested stands excluded from the timber harvesting land base also affects timber supply. In the case of the Merritt TSA, 19% of the total forest land base is covered by these stands. Although they do not contribute directly to the timber supply, these stands can affect how much harvesting can be conducted and the pattern of the harvesting within the TSA by providing old-forest and biodiversity attributes and by affecting the visual impact of harvesting on the timber harvesting land base. Only 7% of the non-timber harvesting land base stands are older than 250 years. Four per cent of the stands are 20 years or younger, 56% are between 21 and 140 years, and 45% are between 141 and 250 years of age.

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of forest stands over time. Forest stands have many characteristics that change over time that could be the subject of growth and yield (for example, number of trees per area, tree diameter, tree height, species composition). Since timber supply analysis concentrates on timber volumes available over time, the most relevant measure for this analysis is volume per area (in British Columbia, cubic metres per hectare). An estimate of timber volume in a stand assumes a specific utilization level, or set of dimensions, that establish the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree.

Based on timber volume estimates*, the current timber inventory on the timber harvesting land base is approximately 115 million cubic metres (excluding wildlife trees retained within cutblocks). About 98 million cubic metres, or 85%, of the volume on the timber harvesting land base are currently merchantable; that is, older than minimum harvestable age. The merchantable volume of forests currently greater than 140 years old is approximately 40 million cubic metres (not including selection management stands).

2.3 Management practices

Timber supply depends on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The *Forest Practices Code of British Columbia Act* and associated regulations guide forest management practices in the Merritt TSA. The focus of the timber supply review is to assess timber supply based on current management practices as implemented in plans for the area. Staff in the Merritt Forest District provided descriptions for the following management practices:

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species. Most areas in the Merritt TSA are harvested using a clearcut harvesting* system and restocked by planting. Selection management stands are assumed to regenerate naturally between harvesting entries.
- Incremental silviculture — where necessary, stands are spaced early in their development to ensure young trees are well distributed to maximize growth. Improved seed from seed orchards is used when possible to increase productivity.
- Forest health and unsalvaged losses* — unharvestable timber losses to fire, wind and insect damage are expected to average 143 626 cubic metres per year.

Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.

Clearcut harvesting
A harvesting method whereby all trees that meet utilization standards are harvested. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding.

Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.

- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting. Volume estimates are based on the utilization of all trees that meet or exceed the following standards: a minimum 10-centimetre top diameter; a maximum 30-centimetre high stump; and a minimum diameter of 17.5 centimetres at 1.3 metres above the ground. The exception is lodgepole pine, for which the minimum diameter is 12.5 centimetres at 1.3 metres above the ground. Utilization standards for smallwood pine stands were assumed to be the same as those for lodgepole pine; however, in reality these smallwood pine stands are utilized to smaller dimensions, as outlined in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Yield models used in this analysis were not calibrated for this level of utilization, and therefore the yield estimates for smallwood pine stands are slightly underestimated in this analysis.
- Patch-size distribution and green-up* — in the Merritt TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (three metres in height for integrated resource management* areas), before adjacent stands may be harvested. The purpose of patch-size distribution guidelines is to have a variety of different-sized openings spread across the landscape. This analysis does not model patch-size distribution, but the objective to prevent timber harvesting from becoming overly concentrated in any landscape unit (LU)* is incorporated by limiting the area that does not meet green-up conditions to a maximum of 33% in the standard resource management area within each landscape unit.
- Protection of elk movement corridors is accounted for in the analysis by ensuring that at least 40% of the area identified as elk movement corridors is covered by forest greater than 20 metres in height and no more than 20% of the forest area is less than 3 metres tall.
- Ungulate* winter range (UWR) — in addition to the elk movement corridors, areas identified as ungulate winter range must have at least 40% of the forest greater than 20 metres in height. In addition, they must meet the green-up requirement of no more than 20% of the forest less than 3 metres tall. These requirements were applied separately to ungulate winter range within each landscape unit.
- Protection of environmentally sensitive areas — areas where potentially unstable soils, avalanche tracks, recreation activities, water protection concerns, forest regeneration problems and habitat for various wildlife have been identified. Where these areas are identified as highly significant, they have been fully excluded from the timber harvesting land base. A total of 34 531 hectares of the Crown productive forest have been excluded from the timber harvesting land base due to environmental sensitivity.
- Community watersheds — management in community watersheds was accounted for by limiting the total forest area less than the green-up height of 6.6 metres to a maximum of 20%. The community watersheds and ungulate winter range may overlap in some places. Thus there may be more than one forest cover requirement applied to an area within the TSA. In cases where the area must meet several requirements, the analysis is designed to ensure that all requirements are met.

Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Integrated resource management (IRM)
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Ungulate
A hoofed herbivore, such as deer.

- Maintenance of scenic values — maintaining important scenic values requires that visible evidence of harvesting be managed within limits in some areas of the Merritt TSA. To approximate visual management in the Merritt TSA, forest cover requirements were applied to limit the amount of area below visual green-up height. The maximum proportion of each scenic area* that may be covered by young stands that do not meet green-up requirements varies depending on the forest characteristics and the visual quality class (VQC) for each area. For example, in areas classified as VQC retention characterized by terrain with an intermediate ability to absorb harvesting disturbance (visual absorption capability), as much as 4% of the forested area may be below 4 metres in height. In areas classified as VQC modification with a low visual absorption capacity, a maximum of 17.5% of the forested area may be below 5 metres in height. See Section A.4.9.5, "Forest cover requirements—visually sensitive areas" in Appendix A for more details.
- Minimum harvestable ages (MHA) — the time it takes for stands to grow to a merchantable condition. The criteria used to define minimum harvestable ages include minimum volume per hectare, achievement of 90% of culmination mean annual increment (CMAI), and a district-defined minimum age. Minimum harvestable ages for existing unmanaged stands range from 80 to 134 years. For managed stands, the MHAs range from 60 to 130 years. Actual harvest age may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Landscape-level biodiversity* — to maintain biological diversity throughout a landscape unit, the *Forest Practices Code* contains targets for the proportion of the area in each biogeoclimatic variant* that should be covered by stands with old- and mature-forest characteristics. In the Merritt TSA, a proportion of the forested area within each biogeoclimatic variant must be covered by stands older than 140 or 250 years, depending on the variant. See Section A.4.9.1, "Forest cover requirements—landscape-level biodiversity" in Appendix A for details.
- Stand-level biodiversity — to maintain biological diversity in forest stands, wildlife trees and wildlife tree patches are retained after harvesting cutblocks. In the Merritt TSA, retention of wildlife trees is estimated to reduce stand-level timber yields by approximately 2%. Retention of wildlife tree patches is estimated to reduce the size of the timber harvesting land base by an additional 2%. Wildlife trees are located both in and outside the timber harvesting land base.

More detailed descriptions of these management practices and the assumptions used to assess their impacts on timber supply are included in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis."

Scenic area
Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives.

Landscape-level biodiversity
The Landscape Unit Planning Guide provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.
Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

Figure 7 shows the proportions of the timber harvesting land base subject to the various forest management objectives. The percentages total to slightly more than 100% due to overlap between resource emphasis areas. Therefore, more than one management objective may be applied to the same area; for example, all or part of a community watershed may also be managed for visual quality. An area managed for an objective such as partial retention visual quality includes non-timber harvesting land base as well as timber harvesting land base. The percentages shown in Figure 7 represent only the timber harvesting land base area subject to that management objective.

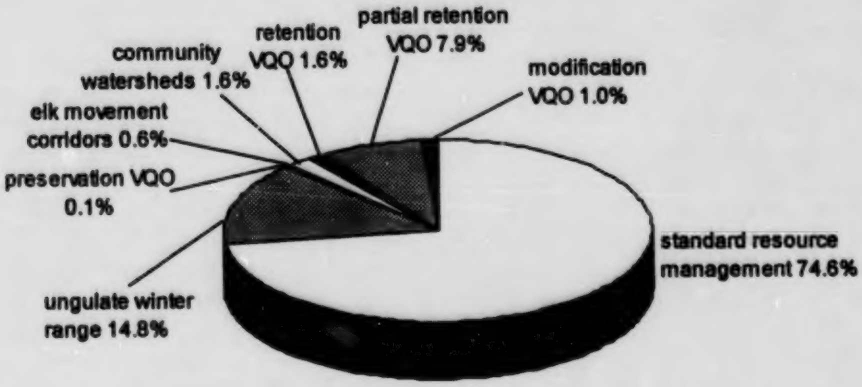


Figure 7. Timber harvesting land base by management emphasis — Merritt TSA timber harvesting land base, 2001.

3 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Merritt TSA under current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used for the analysis. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in generating harvest forecasts (supply of timber over time) using a set of forest management assumptions. The simulation model uses information about the timber harvesting land base, timber volumes, and the management regime to represent how forests grow and are harvested over hundreds of years. There is no presumption that the future can be known hundreds of years from now; the analysis horizon simply reflects that forest-level changes often occur over very long time periods. Generally, only the results for the first 250 years are shown graphically in this report because the projected harvest remains constant after that time.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to specified yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of cutblock adjacency* and green-up prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age, or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only very limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports rather than hinders sustainable forest management in the field.

Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

4 Results

This section presents results of the timber supply analysis for the Merritt TSA. The base case harvest forecast detailed in Section 4.1 uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." Because forest management is inherently a long-term venture, uncertainty surrounds much of the information important in determining timber supply. This uncertainty will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Merritt TSA, and should not be viewed in isolation of the sensitivity analyses.

4.1 Base case and alternative flow harvest forecasts

As explained earlier, the current AAC for the Merritt TSA is 2 004 250 cubic metres per year. Because of the removal of woodlot licence area from the TSA, this report considers the AAC attributable to the TSA to be 1 995 550 cubic metres per year.

This AAC includes a total of 550 000 cubic metres uplift to account for mountain pine beetle salvage (400 000 cubic metres per year) and salvage of timber from the Lawless Creek wildfire area (150 000 cubic metres per year). Because the salvage of timber from the Lawless Creek wildfire was accounted for in the data preparation for the analysis (see Section A.4.7, "Lawless Creek wildfire"), this portion of the uplift was not included in the establishment of the initial harvest level for the base case. Thus, the uplift AAC was assumed to be 1 845 550 cubic metres per year after woodlots were removed.

At the time of the analysis, the uplift had been in place for approximately 2 years. Since this uplift AAC was determined as a temporary measure, it was assumed that harvesting for the remaining 3 years of the first 5-year period of the planning horizon was to occur at the pre-uplift AAC rate of 1 445 550 cubic metres per year. For the purposes of the analysis, these pre- and post-uplift rates were averaged to an annual rate of 1 605 550 cubic metres per year for the first 5 years of the analysis. The pre-uplift AAC rate was used for subsequent harvest levels in the short term.

4 Results

Figure 8 shows the base case harvest forecast* for the Merritt TSA. The base case shows that, taking into account the brief uplift, a harvest level of 1 445 550 cubic metres per year can be maintained for 6 decades. Thereafter, harvest levels decline by approximately 9% per decade over the subsequent 3 decades until the long-term harvest level* is reached in decade 9. The long-term harvest level is 1 116 400 cubic metres per year. The current partition for smallwood pine stands has been maintained for 6 decades. After this time, most of the smallwood pine stands have been harvested once and regenerated to density-managed stands, and the harvest from these stands is allowed to fluctuate. Note that the smallwood pine harvest is included in the base case harvest levels.

Unsalvaged losses due to natural forces such as insects, wind, and fire are estimated to be 143 600 cubic metres per year throughout the planning horizon and have been subtracted from all harvest forecasts shown in this report.

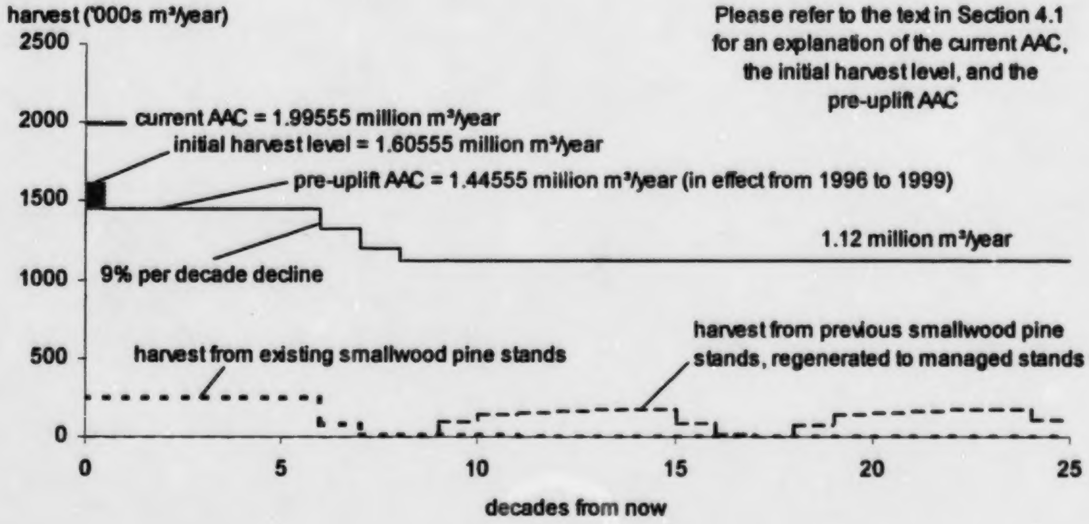


Figure 8. Base case harvest forecast for the Merritt TSA, 2001.

Note that time zero in Figure 8 represents 1999, so that the initial level of 1.606 million cubic metres is the average of two years of harvests at the uplift level set to allow salvage of beetle-damaged timber, and an assumed harvest for the next three years at the pre-uplift level.

Base case forecast
The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

4 Results

Several harvest forecasts are possible for the Merritt TSA within the current management regime as described in previous sections. Prior to selecting the base case, a number of forecasts were developed to analyse the potential timber supply for the Merritt TSA. Figure 9 presents some of these forecasts, and the following paragraphs describe how the alternative forecasts were evaluated, and how the final selection of the base case harvest forecast was made.

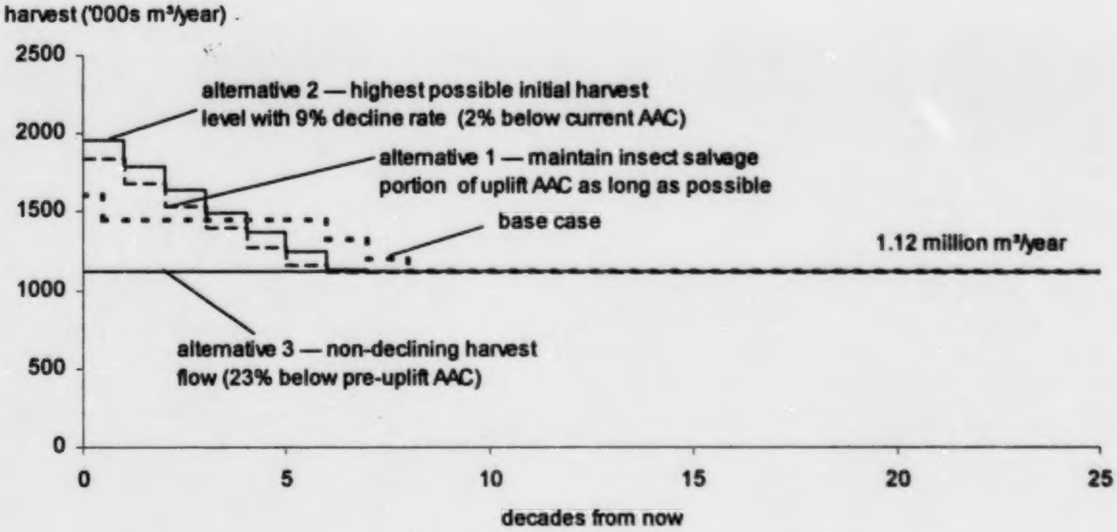


Figure 9. Alternative harvest flows — Merritt TSA, 2001.

One forecast (alternative 1 in Figure 9) tested the feasibility of maintaining the insect-salvage portion of the uplift AAC for as long as possible without causing severe timber shortages in the future. This forecast shows that the uplift AAC of 1 845 550 cubic metres per year could be maintained for an entire decade before the 9% per decade decline to the long-term harvest level would have to commence.

A second forecast (alternative 2) shows the maximum possible harvest rate that could be attained without causing severe timber shortages in the future. In this case, the initial harvest level was raised as high as possible without exceeding a 9% decline rate to the long-term harvest level. Results show that it would be possible to increase the initial harvest level to as high as 1 955 000 cubic metres per year (35% higher than the pre-uplift AAC) without jeopardizing the long-term harvest level or declining at an unacceptable rate to the long-term level. After a decade of harvesting at 1 955 000 cubic metres per year, harvest levels would have to immediately decline by 9% per decade to the long-term harvest level. This harvest forecast is very similar to the previous forecast described. Compared to the other alternative harvest forecasts examined in this section, this forecast provides slightly more timber volume over the planning horizon because the transition to more quickly growing managed stands occurs sooner due to elevated harvest levels in the short and medium term.

A third alternative (alternative 3) is a non-declining harvest flow. The continuous harvest level for this forecast is 1 118 400 cubic metres per year, which is only 2000 cubic metres per year higher than the long-term harvest level in the base case harvest forecast. This level is approximately 23% lower than the pre-uplift AAC. A higher continuous harvest level could be shown for the planning horizon; however, eventually this level would have to decline to the long-term harvest level of 1 116 400 cubic metres per year. For the first nine decades of the planning horizon, this non-declining flow projects a total harvest of approximately 4.7 million cubic metres less than that in the base case.

Figure 10 shows the composition by broad age classs of the timber harvesting land base over time for the base case, the highest initial harvest level (alternative 2), and the non-declining flow alternatives (alternative 3) described above. The change in age class distribution over time shows that, relative to the base case, the timber harvesting land base for alternative 3 includes a higher proportion of stands between the ages of 141 years and 250 years. In addition, less of the timber harvesting land base is occupied by younger stands (less than 140 years) in alternative 3. This result is expected since harvest rates in the non-declining flow alternative are significantly lower than in the base case. Conversely, in the medium term (50 years from now), alternative 2 has fewer stands between the ages of 141 years and 250 years compared to the base case, and correspondingly more stands in very early ages, reflecting the higher harvest rate in this alternative. By 150 years into the planning horizon, the proportions of timber harvesting land base in each age class for alternative 2 are similar to the base case, even though the cumulative timber supply over the first 100 years is about 6% higher in alternative 2 than in the base case. This result suggests that moderate differences in harvest rates, when averaged over long time periods, do not result in large difference in age class composition.

For each time period shown, the amount of timber harvesting land base older than 250 years is the almost same for all three harvest forecasts examined. This occurs because in all three alternatives, the older forests in the timber harvesting land base are projected to be targeted first for harvest. Since there is a relatively small area of the timber harvesting land base in stands older than 250 years, and since they are harvested first within limits imposed by forest cover requirements, the same amount of these old stands is harvested regardless of the harvest flow alternative. Overall, Figure 10 shows that while the different harvest flow alternatives affect the age class structure of the timber harvesting land base to a certain degree, the overall proportions within each age class vary only a small amount by the end of the planning horizon.

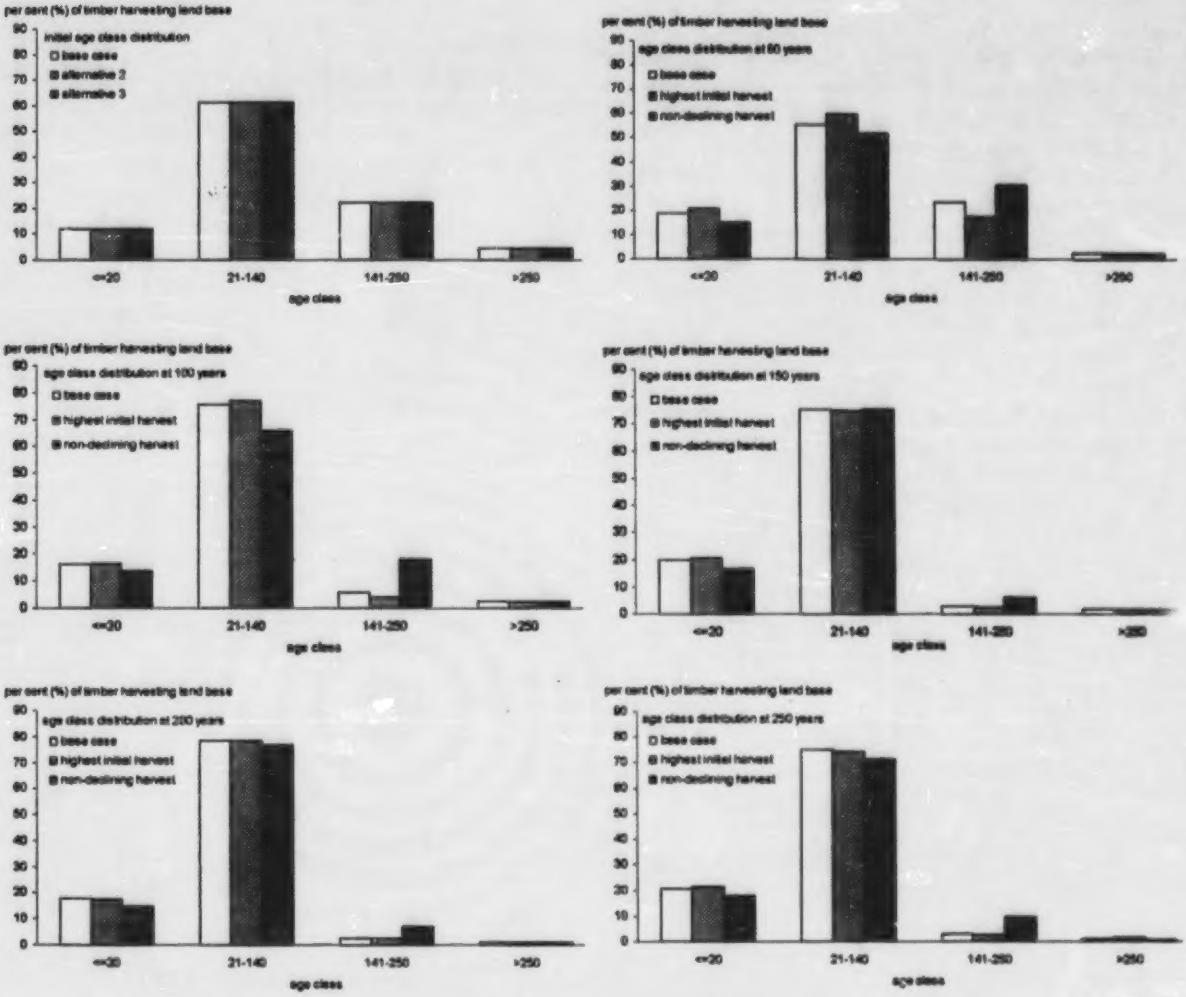


Figure 10. Changes in age class distribution over time, alternative harvest flows — Merritt TSA, timber harvesting land base, 2001.

4 Results

The base case harvest forecast was chosen from the forecasts described above because short-term harvest levels in the base case are based on pre-uplift AAC levels, and the uplift AAC had been granted to deal with a temporary issue that district staff have indicated has largely been addressed. This harvest forecast is the only one for which a downward adjustment would not be required either immediately or after the first decade. In the absence of compelling forest management reasons (e.g., insect infestations or wildfire damage) the chief forester has not generally accepted as a basis for AAC determinations timber supply forecasts that increase above current harvest levels, only to decline within the near future. This type of forecast would tend to result in increased economic activity, followed in quick succession with forced reductions. More stable forecasts are believed to be more acceptable. Nevertheless, evaluation of alternatives is useful for assessing the relative stability of a full range of forecasts.

4.1.1 Base case timber supply dynamics

As shown by the current age class composition (Figure 6), the forest in both the timber harvesting land base and the non-timber harvesting land base is fairly well-distributed across all age classes, with 60% of the timber harvesting land base at or above the minimum harvestable ages. Figure 11 shows that this distribution enables a smooth transition of harvesting from existing natural stands to managed stands for the base case. The transition from existing to managed stands starts in decade 7 and by decade 11, managed stands contribute approximately 90% of the harvest. Selection management stands contribute between 0% and 7% of the total harvest volume throughout the planning horizon.

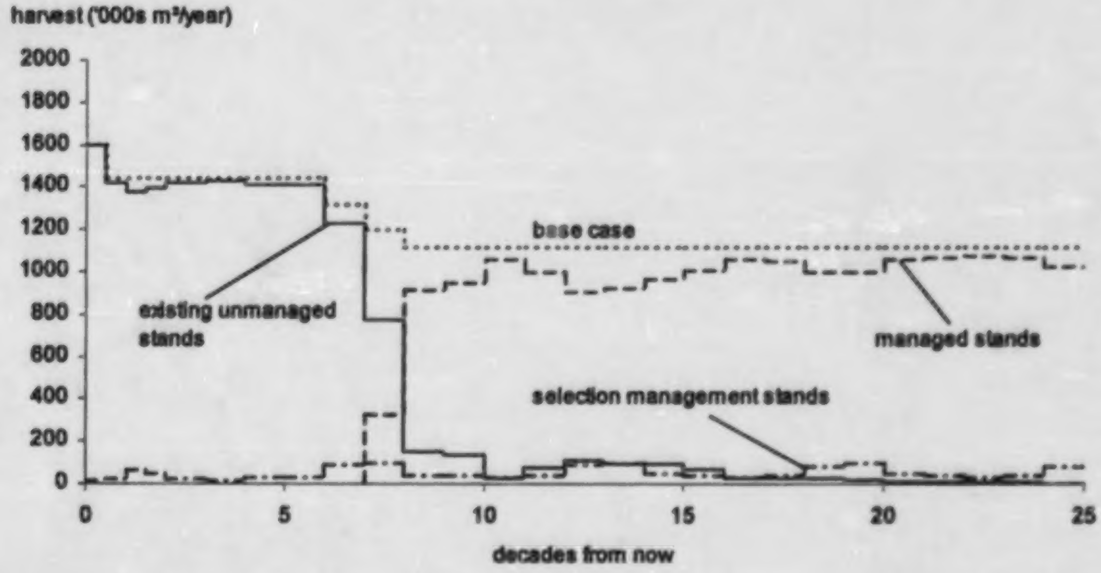


Figure 11. Harvest contribution from the unmanaged and managed stands — Merritt TSA, 2001.

The long-term harvest level was defined as the maximum harvest rate at which the total timber growing stock* is maintained at an even level, on average, indicating that harvesting can continue at that level in perpetuity (see Figure 12). A continually declining growing stock would signify that timber is being harvested above the productive capability of the land.

Figure 12 shows the change of growing stock over time for the base case harvest forecast. As existing mature stands are harvested and replaced with younger stands on the timber harvesting land base, the total growing stock declines. This decline takes place over the next 8 decades, until the long-term harvest level is reached. Over the long term, total growing stock averages 65 million cubic metres in the base case harvest forecast.

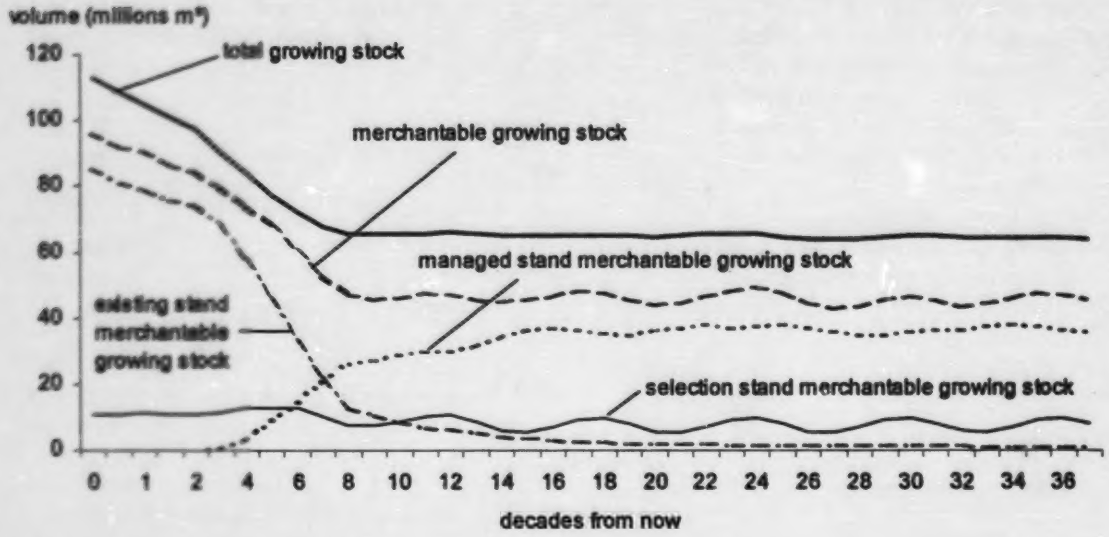


Figure 12. Total and merchantable growing stocks — Merritt TSA timber harvesting land base, 2001.

This figure also shows the merchantable timber volumes throughout the planning horizon. In this analysis, 'merchantable' denotes stands that are old enough to harvest; in other words, older than their minimum harvestable ages. Figure 12 shows the present abundance of merchantable timber, as well as the decline of merchantable growing stock over time. The merchantable growing stock averages about 46 million cubic metres in the long term, and is comprised mainly of managed stands and, to a lesser extent, of selection management stands. In the long term, a small volume of merchantable existing stands persists in the timber harvesting land base. This occurs because some existing stands remain throughout the planning horizon to fulfill old-forest requirements for landscape-level biodiversity and, to a lesser extent, to meet deer winter range and elk requirements for older forests.

Growing stock
The volume estimate for standing timber at a particular time.

4 Results

Some managed stands are merchantable as early as 30 years into the planning horizon. However, these stands do not get harvested in the base case until 80 years into the planning horizon. Managed stands are not harvested immediately when they become merchantable because existing stands are abundant, and older stands are prioritized for harvest in the simulation.

The growing stock for merchantable selection management stands fluctuates throughout the planning horizon because these stands tend to get harvested on a cyclical basis. They then revert to an immature state for at least another 30 years, after which they are again considered available for re-entry. As with existing unmanaged stands, some selection management stands are retained at old ages to meet old-forest cover requirements.

The average growth rate projected for managed stands when they are at their age of highest productivity (CMAI) is 2.6 cubic metres per hectare per year, about 37% more than the 1.9 cubic metres per hectare per year for existing natural stands (excluding selection management stands). Higher growth rates are expected in managed stands because stocking levels are expected to be controlled to ensure full site occupancy while avoiding over-stocking that would cause severe competition among trees. The full benefit of silvicultural management will not be realized until most second-growth stands become available for harvesting, in 90 to 120 years from now. However, because stand management is anticipated to result in more volume being available for harvest sooner it allows for higher harvests from existing stands over the short and medium terms as well.

The long-term harvest level is below the maximum productive capacity of the timber harvesting land base. Because of forest cover requirements for maintaining wildlife habitat, maximum allowable disturbance levels, and the objective of maintaining a relatively even harvest flow over time, stands are not necessarily being scheduled for harvest at the time of maximum average productivity. Theoretically, if all stands were harvested at the age of maximum average productivity (without area constraints), an average annual harvest rate of approximately 1.35 million cubic metres (approximately 7% higher than the long-term harvest level in the base case harvest forecast) could be achieved in the long term.

Old-forest cover requirements for landscape-level biodiversity, deer, and elk do limit timber supply throughout the planning horizon. While forested areas outside the timber harvesting land base can meet some of the forest cover needs over time, portions of the timber harvesting land base must be maintained in older forests to meet some of the older forest cover requirements in the medium and long term. In addition, harvest levels are limited by the amount of timber of a harvestable age in the medium and long term, and by the maximum allowable disturbance in some community watersheds and areas subject to visual quality objectives.

The base case harvest forecast in this analysis presents a different forecast of timber supply than the previous analysis completed for the Merritt TSA (September 1994). As discussed above in Section 2.1, "Land base inventory," the timber harvesting land base has increased by approximately 25%, mostly by explicitly including smallwood pine, and including some problem forest types previously considered outside the timber harvesting land base. As a result, the long-term harvest level is significantly higher in this analysis than in the 1994 analysis. However, there is less timber supply available in the medium term compared to the 1994 analysis. That analysis showed that the current AAC at that time (approximately the same as the pre-uplift AAC referenced in this analysis, minus the contribution from smallwood pine stands) could be maintained for an additional 11 decades. In this analysis, this level of harvest can only be maintained for 6 decades. Community watershed forest cover requirements were added for this analysis. Elk management areas were included in the timber harvesting land base, and reductions for riparian management were increased. Finally, non-recoverable losses (NRL) were approximately 30 000 cubic metres per year higher for this analysis.

4.2 Average age, area, and volume harvested

Figure 13 shows the change in the area-weighted average harvest age resulting from the base case forecast. The pattern of harvested age over the first 90 years of the planning horizon reflects that the highest harvest priority was assigned to those stands furthest above their minimum harvestable age (relative oldest first). Average harvested age is at its minimum after 110 years, when the transition from harvesting mostly existing older stands to younger, second-growth stands is almost complete and there are few older stands remaining to harvest. As a result, the second-growth stands get harvested close to their minimum harvestable ages. From 100 years onwards, the area-weighted average harvested age fluctuates around 110 years. Much of the fluctuation is caused by the somewhat cyclical pattern of harvesting in the selection management stands, which are generally harvested at older ages than the managed stands. Figure 13 also shows the range of ages harvested through time. The two dashed lines in Figure 13 show the maximum and minimum harvest ages for each period. The maximum harvest age line indicates that there are some extremely old stands being harvested each period, in some cases, older than 500 years. Particularly in the long term, these old stands are those that were being used to meet forest cover requirements for landscape-level biodiversity that are made available for harvest once non-contributing forest areas have aged enough to meet the requirements, as well as retention VQO and selection harvest areas. The results show stands aging to possibly unrealistically old ages in order to meet management objectives for non-timber values before they can be harvested. However, these old stands comprise only a very small fraction of the total harvest. Figure 13 also includes two lines showing all but the youngest 5% and the oldest 5% of harvested stands (by volume). These lines show that for most of the harvested stands (90% of the volume harvested) the variation around the average harvest age is not as extreme as the maximum and minimum harvest age graphs would suggest. After 150 years from now, the variation around the average harvest age is approximately plus or minus 30 to 40 years.

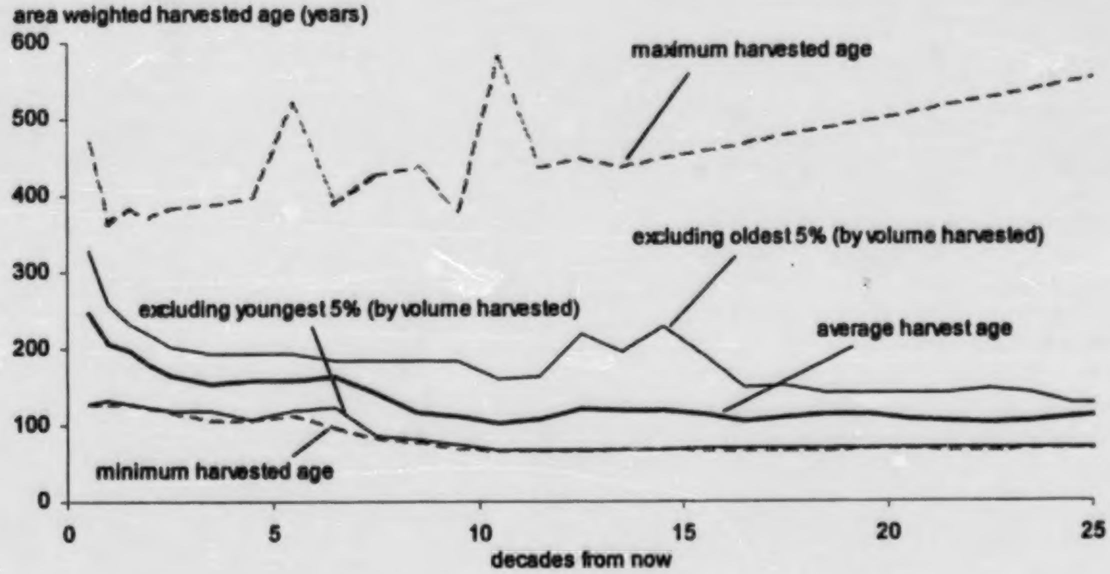


Figure 13. Average age of stands harvested over time — Merritt TSA base case, 2001.

Figure 14 shows the average annual area harvested over the next 250 years for the base case harvest forecast. Area harvested is projected to range from a minimum of about 5500 hectares per year in decade 8 to a maximum of 7900 hectares per year in decade 13. During the first 6 decades, even though the harvest level remains the same, the area harvested is projected to increase as the harvest shifts from the oldest stands with the highest total volume to younger stands with lower total volumes. In the long term, the area harvested fluctuates because the harvest comes from stands of different productivity and age. In addition, because selection harvest yields a lower volume per hectare than clearcutting, a greater area must be harvested to obtain the same amount of volume. Thus the total area harvested is higher in those decades when there is relatively more selection harvesting.

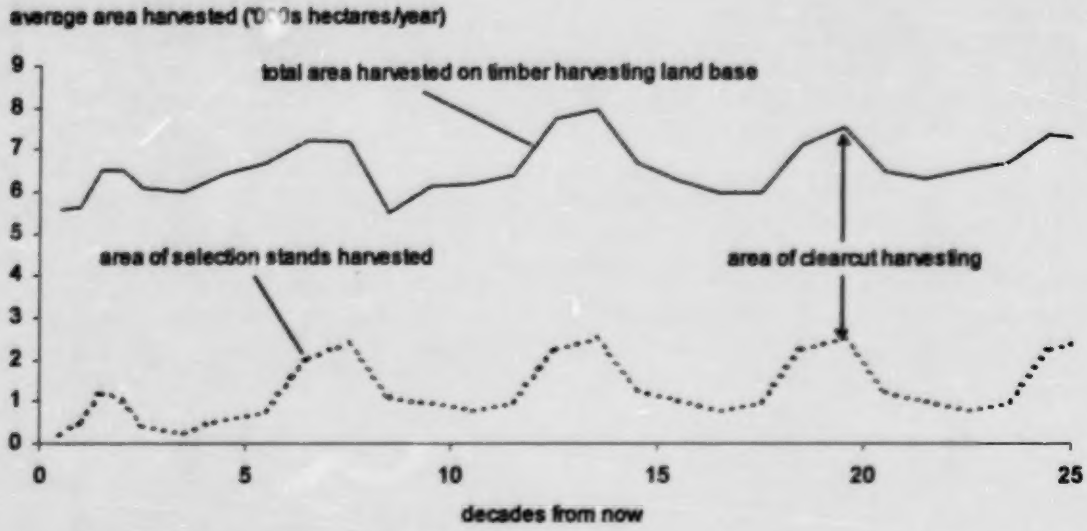


Figure 14. Average area harvested over time — Merritt TSA base case, 2001.

Figure 15 (next page) shows the average timber volume per hectare harvested over the next 250 years under the base case harvest forecast. The average volume per hectare varies from the highest of 314 cubic metres per hectare in the first 5 years of the planning horizon, to 159 cubic metres per hectare in decade 13. The volume per hectare values shown in Figure 15 also include timber yields from selection management stands, from which only 25% of the total volume is harvested. When Figure 15 is compared to Figure 14, it can be seen that the average volume per hectare harvested is higher when the area harvested is lower, and lower when the area harvested is higher. This relationship is expected since the base case projects a constant total volume harvest over the long term.

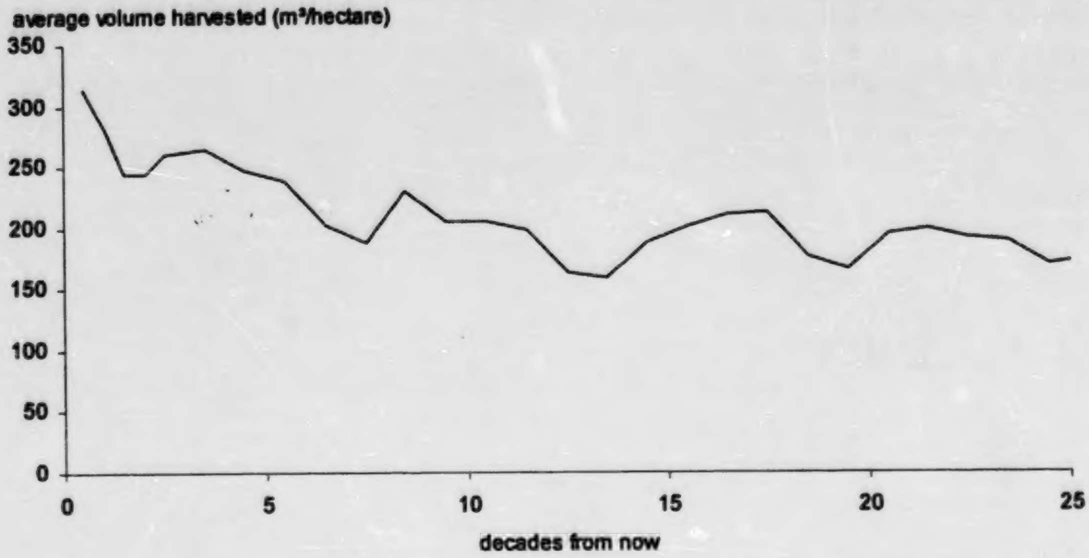


Figure 15. Average volume per hectare harvested over time — Merritt TSA base case, 2001.

4.3 Age class profile over time

The charts in Figure 16 show how the age composition of the forest both in the timber harvesting land base and in the non-timber harvesting land base of the Merritt TSA is projected to change over time under the base case harvest forecast.

Currently, stands both within and outside the timber harvesting land base are fairly well distributed across all age classes. A significant amount of the forest (29%) is older than 140 years, but only 5% of the forest is covered by stands older than 250 years.

Most of the timber harvesting land base (61%) is covered by stands between the ages of 21 to 140 years. Approximately 22% of the timber harvesting land base is between the ages of 141 and 250 years; only 4% is older than 250 years.

The non-timber harvesting land base has slightly higher proportion of older stands with 34% between the ages of 141 and 250 years, and 7% older than 250 years. The relative scarcity of older stands is believed to reflect a reasonably frequent occurrence of historical disturbance (mostly caused by forest fires and insects).

One consequence of the small proportion of stands greater than 250 years is that the old-growth requirements for landscape-level biodiversity in some variants of the Interior Douglas-fir, Ponderosa Pine, and Coastal Western Hemlock biogeoclimatic zones are not met for many periods at the beginning of the harvest forecast. This lack of older forest of some biogeoclimatic variants in some landscape units does not necessarily mean that merchantable forest cannot be harvested. The forest estate model used by the B.C. Forest Service reserves some of the older forest from the timber harvesting land base needed to meet old-growth objectives until stands outside the timber harvesting land base can meet the requirements. Therefore, some forested areas younger than 250 years are reserved to meet old-growth requirements. Since almost 60% of the forest on the timber harvesting land base is currently old enough to harvest, there are sufficient merchantable stands to maintain harvest levels even though some older stands are reserved from harvest. Reserving of stands for a long time extends the period over which existing stands are harvested, and results in small fluctuations around average volume and area harvested into the long term.

Beyond 100 years from now, the age distribution of the forest within the timber harvesting land base becomes relatively even. Some stands in the timber harvesting land base are not harvested until well beyond their minimum harvestable ages because they are maintained to meet forest cover requirements. Stands outside the timber harvesting land base are assumed to age throughout the planning horizon.

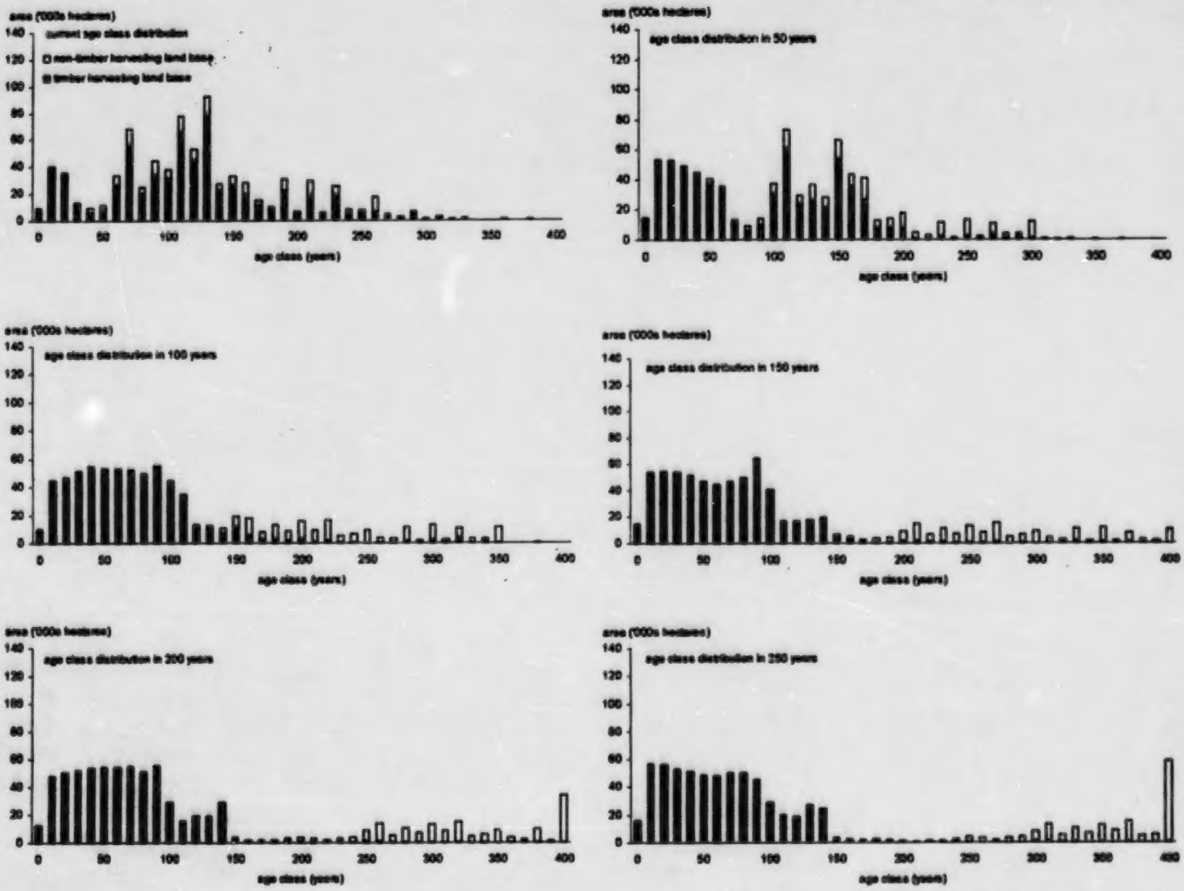


Figure 16. Changes in age composition on the productive land base over time — Merritt TSA base case, 2001.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is a complicated endeavor that must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human life spans, which means that decisions we make today have not only short-term but also long-term effects. In such a context, we cannot be certain that all data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how values of interest, for example, timber supply, could change if the information used in the analysis is not accurate. Sensitivity analysis* is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide safe basis for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of several sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions and data used in the base case.

Unsalvaged losses to natural forces such as insects and fire are estimated to be 143 626 cubic metres per year for the entire 250-year horizon, and have been subtracted from all harvest forecasts shown in this report.

5.1 Uncertainty in the estimated area of the timber harvesting land base

Uncertainty in the estimated size of the timber harvesting land base is due to factors such as fluctuations in timber prices, changes in harvesting and milling technology and land-use decisions.

Another factor is the uncertainty around the use of regional or provincial averages in defining the land base when localized data are not available. For example, average retention recorded in silviculture prescriptions, combined with retention level guidelines were used to estimate the appropriate reductions for WTPs on the timber harvesting land base.

When the analysis was undertaken, there was no evidence to suggest that the timber harvesting land base was either over- or underestimated. However, two sensitivity analyses were performed to provide general information on how land base uncertainty could affect the timber supply forecast. The first evaluates the outcome of increasing the timber harvesting land base by 10% (66 032 hectares), then reducing the non-timber harvesting land base by 66 032 hectares. The second evaluates the outcome of decreasing the timber harvesting land base by shifting 10% (66 028 hectares) of the timber harvesting land base to the non-timber harvesting land base.

Sensitivity analysis
A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.

Sensitivity analysis shows that if the base case overestimated the timber harvesting land base, there is still sufficient area in older existing stands to support the base case levels for 4 decades before declining to medium- and long-term levels approximately 9% lower than in the base case. The effect on the long-term harvest level is not exactly proportionate to the change in the size of the timber harvesting land base because those stands no longer considered part of the timber harvesting land base continue to contribute to forest cover requirements for wildlife and biodiversity. Therefore, slightly more timber can be harvested from those portions of the timber harvesting land base constrained by older forest cover requirements than in the base case.

If the timber harvesting land base is 10% larger than in the base case, the decline to the long-term harvest level is delayed until 9 decades from now. The long-term harvest level is approximately 7% higher than in the base case. The increase in the long-term harvest level is not proportionate to the increase in the size of the timber harvesting land base because the size of the non-contributing forest is reduced by the same amount the timber harvesting land base is increased. Since the non-contributing forest is needed to meet biodiversity and wildlife older forest requirements in the long term, reducing the amount of non-contributing forest requires that more of the timber harvesting land base must be retained in older forest classes to meet these constraints compared to the base case. Therefore, the long-term harvest level is increased only by 7% for a 10% land base increase.

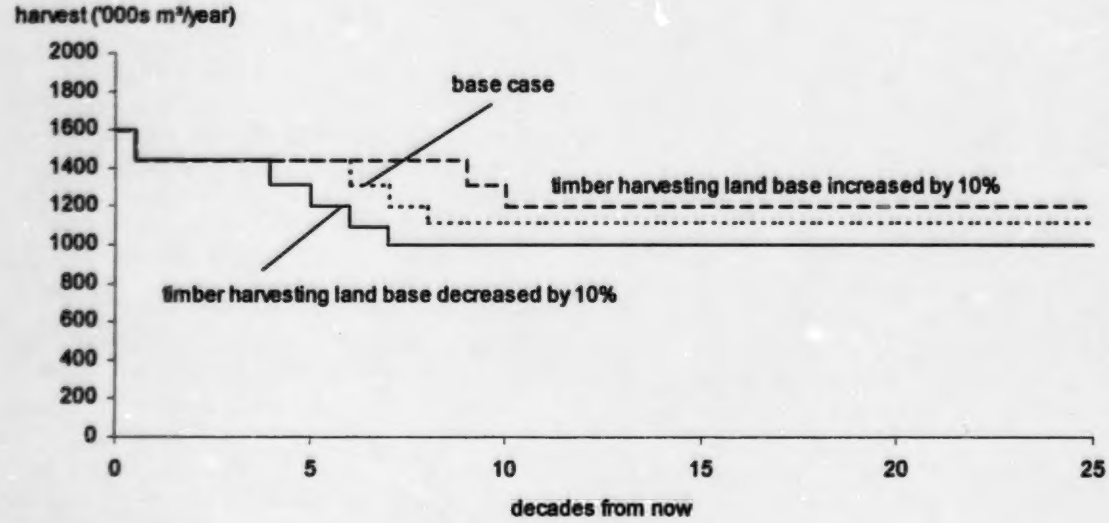


Figure 17. Land base sensitivity analysis — Merritt TSA, 2001.

5.2 Uncertainty in the estimated time to green-up

Forest cover requirements for visual quality, wildlife habitat, water quality and adjacency applied in this analysis involve estimates of when stands will reach green-up conditions, expressed as the desired height of a stand (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for green-up heights for each management emphasis area). Some uncertainty surrounds green-up requirements because they approximate the effects of cutblock-level decisions, and it is difficult to define the exact forest structure needed to meet the cover objectives for a particular area. Furthermore, there is uncertainty about how requirements will be implemented in the field. To examine this uncertainty, green-up ages were increased and decreased by 5 years for the standard management, visual quality management, elk movement corridor, ungulate winter range, and community watershed management areas.

Figure 18 shows that, within the range tested, timber supply is not significantly affected by changes in the time to green-up. If green-up ages are decreased by 5 years, a small amount of additional timber is available in the long term (less than 1% more than in the base case) because requirements in visual quality management, wildlife, and watershed emphasis areas become less limiting. Other than this slight impact, there is no effect on timber supply in either case examined.

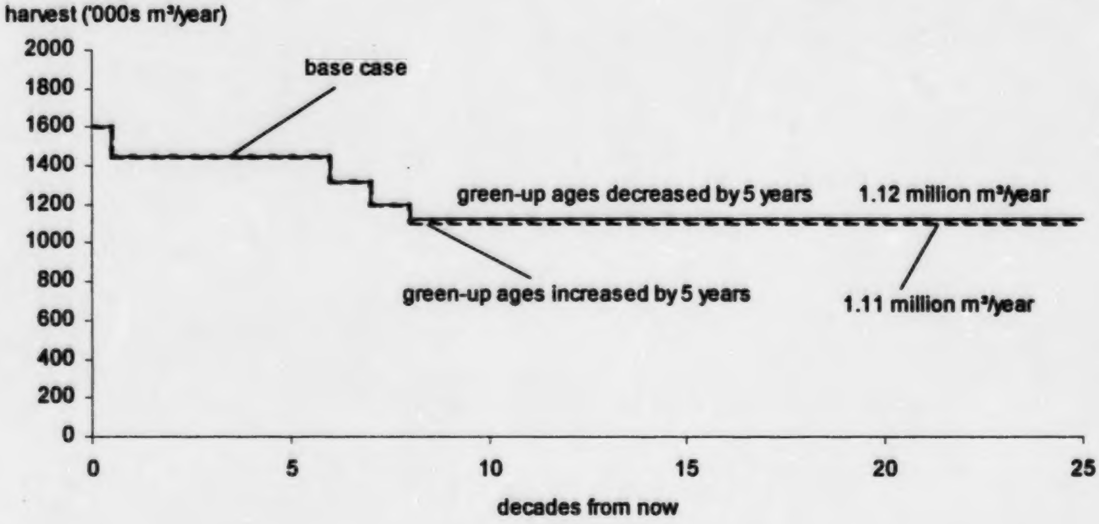


Figure 18. Harvest forecasts if green-up ages were either 5 years longer or shorter than in the base case — Merritt TSA, 2001.

5.3 Uncertainty in the estimated existing stand yields

Timber volume estimates for existing unmanaged stands are subject to uncertainties in the forest inventory used to estimate timber volumes (i.e., estimated tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. Although no specific issues were identified during the inventory audit of the Merritt TSA, a standard sensitivity analysis was performed to test the potential effect on timber supply of uncertainty in the estimates of existing unmanaged stand volumes. The results of decreasing and increasing existing unmanaged stand yield estimates by 10% are presented in Figure 19.

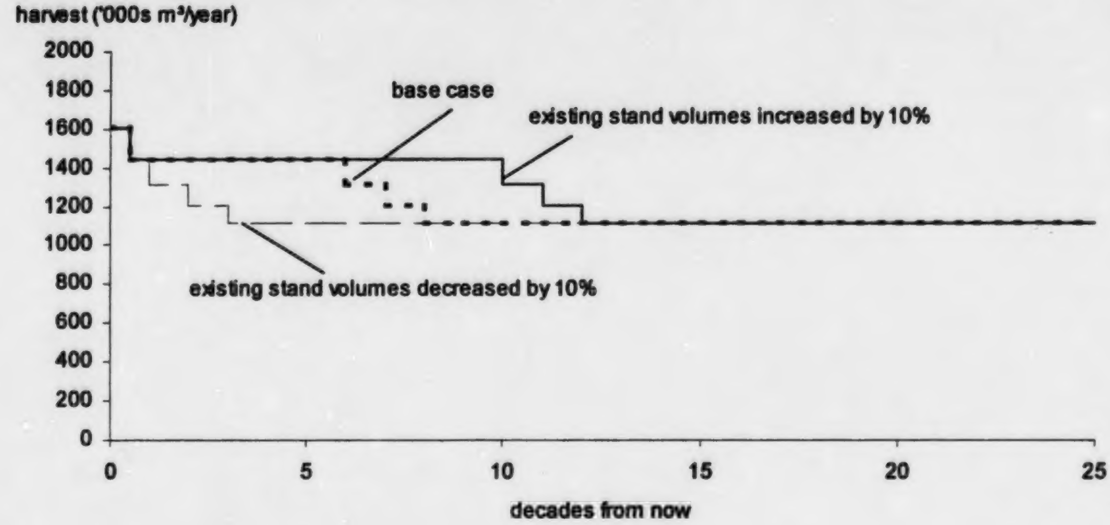


Figure 19. The effect on the harvest forecast of increasing and decreasing volume estimates for existing unmanaged stands by 10% — Merritt TSA, 2001.

When existing unmanaged stand volumes are increased by 10%, the increased volume enables the decline to the long-term harvest level to be delayed until 10 decades from now. Conversely, if existing stand volumes are decreased by 10%, harvest levels must decline to the long-term harvest level immediately after the first decade to avoid future disruptions in timber supply. In both cases, the long-term harvest level is not affected by the change in existing stand volume estimates because the long-term harvest level depend mainly on managed stand volumes.

5.4 Uncertainty in estimated managed stand yields

Uncertainty in volume estimates for managed stands exists for the same reasons listed for existing stand yields (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and data that is available for regenerated managed stands in B.C. There is also uncertainty about the site productivity assigned to older unmanaged stands relative to the site productivity expressed by the stands after they are harvested and regenerated. This issue is examined in Section 5.5, "Uncertainty in the productivity of current old-growth sites after harvest." Also, there is uncertainty about the site productivity of stands currently described as 'smallwood pine' relative to the site productivity expressed by the stands after they regenerate. This issue is examined in Section 5.6, "Uncertainty in the productivity of current smallwood pine sites after harvest."

As with existing unmanaged stand yield estimates, there are no specific issues directly related to managed stand yield estimation, other than site productivity estimates. Therefore, a standard sensitivity analysis, in which managed stands yields were increased and decreased by 10%, was performed. Figure 20 presents the results. If volume estimates for regenerated stands are 10% higher than assumed in the base case, the long-term harvest level would be increased by approximately 10% to 1.24 million cubic metres. This level is reached in decade 7, two decades earlier than in the base case. If volume estimates are 10% lower than in the base case, the long-term harvest level is decreased by 10% to 0.99 million cubic metres per year. Changes in regenerated stand volumes only affect harvest levels after decade 7 when regenerated stands become available to harvest (see Figure 11, "Harvest contribution from the unmanaged and managed stands"). Neither of these harvest forecasts account for any associated changes in minimum harvestable ages that could results from changes in stand yields (see Section 5.8 "Uncertainty in estimates minimum harvestable ages").

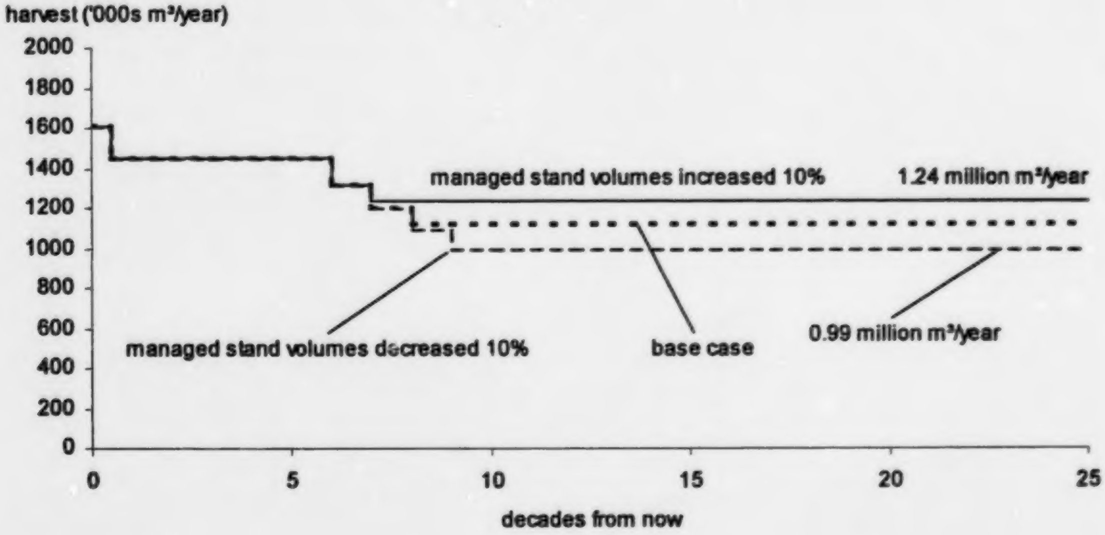


Figure 20. The effect on the harvest forecast of increasing and decreasing volume estimates for managed stands by 10% — Merritt TSA, 2001.

5.5 Uncertainty in the productivity of current old-growth sites after harvest

The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the time to reach green-up and the age at which stands are predicted to reach merchantable size. The most accurate estimates of site productivity come from stands between 30 and 150 years old. At ages less than about 30 years a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand. At older ages, site productivity estimates may be incorrect because tree heights do not represent actual productivity — for example due to top breakage — and it is very difficult to determine ages of old trees accurately.

The results of recent province-wide research suggest that the estimated post-harvest productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two *Old Growth Site Index* (OGSI) studies applicable to timber supply forecasting are:

- *Site index adjustments for old-growth stands based on paired plots* (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged and regenerated stands of the same productivity. Site index was estimated for both and comparisons were made. Results are available for lodgepole pine, interior spruce and coastal Douglas-fir.
- *Site index adjustments for old-growth stands based on veteran trees* (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with a veteran and main stand component. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the study are considered less reliable than those from the paired-plot study.

The results of these two studies apply only to stands older than 140 years, which comprise approximately 20% of the Merritt TSA timber harvesting land base. To test the sensitivity of the base case harvest forecast to uncertainty about site index estimates, site indices of these older stands were adjusted using either the paired plot or veteran-tree results, whichever was applicable. Timber supply analysis inputs affected by changes in estimated future productivity (managed stand volume estimates, green-up ages and minimum harvestable age) were recalculated based on average site productivity. Table 3 (next page) compares the average forest inventory-based site index for each old-growth analysis unit* older than 140 years to those defined using the OGSI adjustments.

Analysis unit
A grouping of types of forest - for example, by species, site productivity, silvicultural treatment, age, and or location, done to simplify analysis and generation of timber yield tables.

Table 3. Average analysis unit site index based on forest inventory and OGSI information — Merritt TSA, 2001

Analysis unit	Area (hectares)	Inventory site index	Adjusted site index
Fir wet good/medium > 140 years	7 301	16.9	19.2
Fir wet poor > 140 years	7 003	13.3	16.9
Pine/fir good/medium > 140 years	7 815	16.7	20.5
Pine/fir poor > 140 years	14 779	12.8	19.7
Pine/spruce good/medium > 140 years	14 055	17.6	20.6
Pine/spruce poor > 140 years	19 747	12.0	18.9
Pine good/medium > 140 years	9 101	16.9	20.5
Pine poor > 140 years	14 579	12.9	19.8
Balsam/hemlock good/medium > 140 years	2 017	14.7	18.0
Balsam/hemlock poor > 140 years	10 738	10.4	15.2
Spruce/pine/cedar good/medium > 140 years	7 872	17.5	21.0
Spruce/pine/cedar poor > 140 years	15 739	10.8	19.3
Smallwood pine > 140 years	2 482	9.9	19.2

Results of the OGSI sensitivity analysis, shown in Figure 21, indicate that the decline to the long-term harvest level could be delayed until 17 decades into the future. In addition, the long-term harvest level could be approximately 15% higher than in the base case. Site index adjustments are not included in the base case since there is little local site productivity data or long-term monitoring of regenerated stands to support the adjustments. However, the results of the sensitivity analysis do provide insight into the possible trends associated with site productivity estimates for the Merritt TSA and indicate that long-term timber supply is likely higher than currently estimated in the base case.

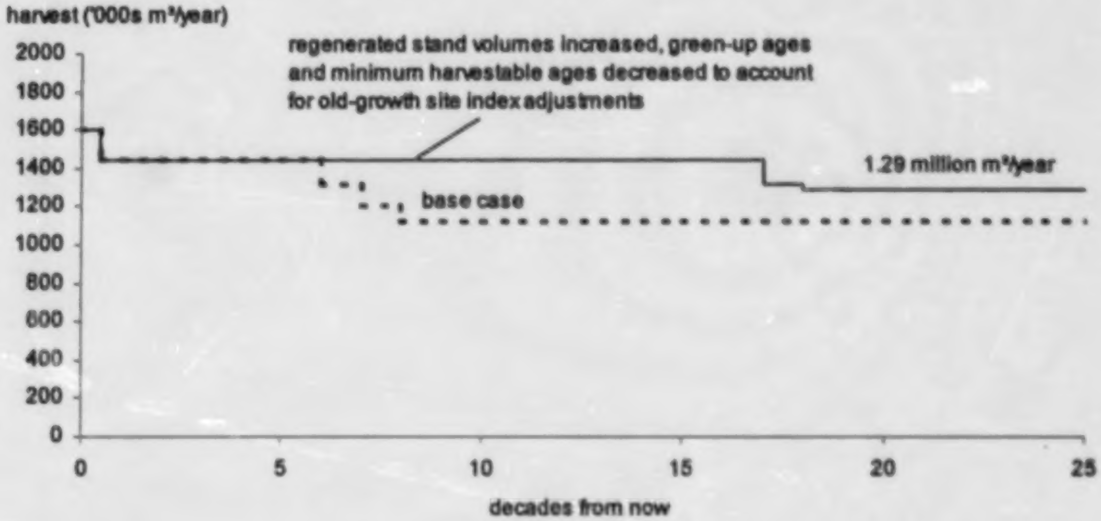


Figure 21. Harvest forecast based on OGSI (paired plot and veteran studies) site index adjustments — Merritt TSA, 2001.

5.6 Uncertainty in the productivity of current smallwood pine sites after harvest

The timber harvesting land base for the Merritt TSA includes approximately 93 500 hectares of smallwood pine stands. These stands are comprised of short pine trees that have been growing under suppressed conditions. District staff believe that the site productivity, measured in terms of height growth over time, has been underestimated as a result of the exceptionally suppressed conditions under which these stands have grown. For the analysis, site index data gathered by biogeoclimatic site series for the *Site Index Estimates by Site Series Project* (SIBEC) were applied by biogeoclimatic variant to smallwood pine stands to derive an actual site productivity estimate. On the basis of these assessments, the site index assigned to smallwood stands after they regenerate was increased from 11.7 metres in the base case to 16.4 metres. The trends indicated by these adjustments were confirmed by field measurements taken to estimate the site productivity being expressed by young stands regenerating on sites that had been occupied by smallwood pine. These productivity estimates were then compared to the site indices measured for adjacent smallwood stands to determine how much site productivity was being underestimated.

The SIBEC adjustments increased managed stand volume estimates, decreased the amount of time to achieve green-up conditions, and reduced minimum harvestable ages for stands regenerating on sites currently occupied by smallwood pine stands.

Figure 22 shows the results of this sensitivity analysis. The graph shows that if smallwood pine site indices are higher than assumed in the base case, the long-term harvest level could be higher. In this case, a 4.7-metre increase in site index increases the long-term harvest level by approximately 8% to 1.21 million cubic metres per year. This adjustment was not included in the base case because confidence about the appropriate magnitude of adjustment for these stands awaits more study of their inherent site productivity. However, the sensitivity analysis results provide an insight into the potential effect of underestimated site productivity in these stands and indicate that long-term timber supply is likely higher than currently estimated in the base case.

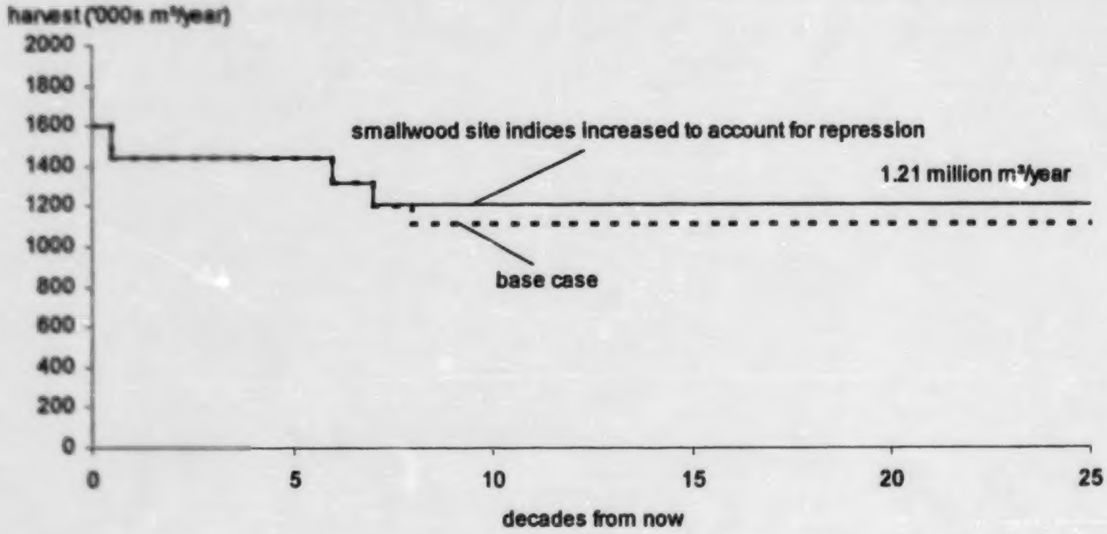


Figure 22. Harvest forecast based on smallwood stand site index adjustments — Merritt TSA, 2001.

5.7 Uncertainty in the growth rate of seedlings from seed orchards

Reforestation following harvesting is required by law in British Columbia and the *Forest Practices Code* requires reforesting with seedlings grown from selected seed if they are available. For the past 40 years in B.C., efforts have been made to select and breed trees with desirable traits such as faster growth, better stem and wood quality, and resistance to diseases and insect attack. Tree breeding offers potential gains in timber supply through increases in growth rate that may reduce minimum harvestable ages, increase volume at time of harvest, and ease adjacency constraints through faster green-up. Seed selected through the tree breeding program can be obtained from seed orchards located throughout the province.

In the Merritt TSA, spruce seedlings from the tree breeding program planted from 1998 to 2000 are expected to grow approximately 2.5% faster than conventional seedlings. The pine seedlings planted during this time period are expected to grow approximately 6% faster. Since these tree-breeding program seedlings comprise only a portion of all seedlings planted (55% of all spruce, and 12% of all pine planted in the last 3 years), the average growth increase expected for all planted spruce is 1.4%, and for all planted pine is 0.7%. The growth rate increases stated here are applicable only for a certain range in site productivity and at a specific age (80 years for spruce, and 60 years for pine). For example, if a spruce stand planted in the last 3 years with some seedlings originating from a seed orchard has been planted on a medium productivity site, it would be expected to have 1.4% more volume at age 80 years than a similar stand without any tree-breeding program seedlings. However, the difference in volume yield would decrease after 80 years to almost no volume difference between the two stands by age 200 years.

Since the expected growth impact of the present use of selected seed is very small, this issue was not explicitly analysed. It is expected that future plantations will include a much greater proportion of seedlings from selected seed, but what proportion, and how much faster these seedlings will grow, has not been reliably quantified at this time. As more information becomes available, it can be assessed in future analyses.

5.8 Uncertainty in estimated minimum harvestable ages

Minimum harvestable age is an estimate of the time needed for a stand to reach a merchantable condition. The time at which stands will become merchantable is highly uncertain. This is partly because of uncertainty about the growth of regenerated stands, but more importantly because we cannot foresee future conditions that will determine merchantability.

For this analysis, different criteria were used for defining minimum harvestable ages for existing unmanaged stands, selection management stands, and managed stands. For existing unmanaged stands, minimum harvestable ages were estimated as the age at which stands accumulated an average merchantable volume of 150 cubic metres per hectare, or default minimum ages (80 years for pine-dominated stands; 100 years for other coniferous stands) if the volume criterion resulted in ages that district staff believed to be too young. Selection management stands were given a minimum harvestable age of 120 years. For managed stands, the minimum harvestable age was based on the achievement of 90% of maximum, (or culmination)* mean annual increment (MAI)*. These minimum stand harvest age criteria are described in detail in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." The minimum harvestable ages are minimums; in this analysis stands may be harvested at older, but not younger, ages. In fact, many stands are projected for harvest at ages beyond the minimum in order to meet management objectives and forest cover requirements, as illustrated in Figure 13. Minimum harvestable ages are meant to approximate the timing of merchantability, and are not legal or policy requirements.

Culmination age
The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize volume production from a growing site.

Mean annual increment (MAI)
Stand volume divided by stand age. The age at which average stand growth, or MAI, assumes its maximum is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.

Figure 23 shows how timber supply would change if stands in fact become merchantable either earlier or later than assumed for the base case.

If minimum harvestable ages were increased or decreased by 10 years, long-term timber supply would change only slightly. Increasing the minimum harvestable ages by 10 years increases the long-term harvest level by a very small amount (less than 1%) since stands get harvested at slightly older ages and therefore at a higher overall volume compared to the base case. Decreasing the minimum harvestable ages by 10 years decreases the long-term harvest level by a small amount (1%) since younger stands with slightly lower volumes are selected for harvest compared to the base case.

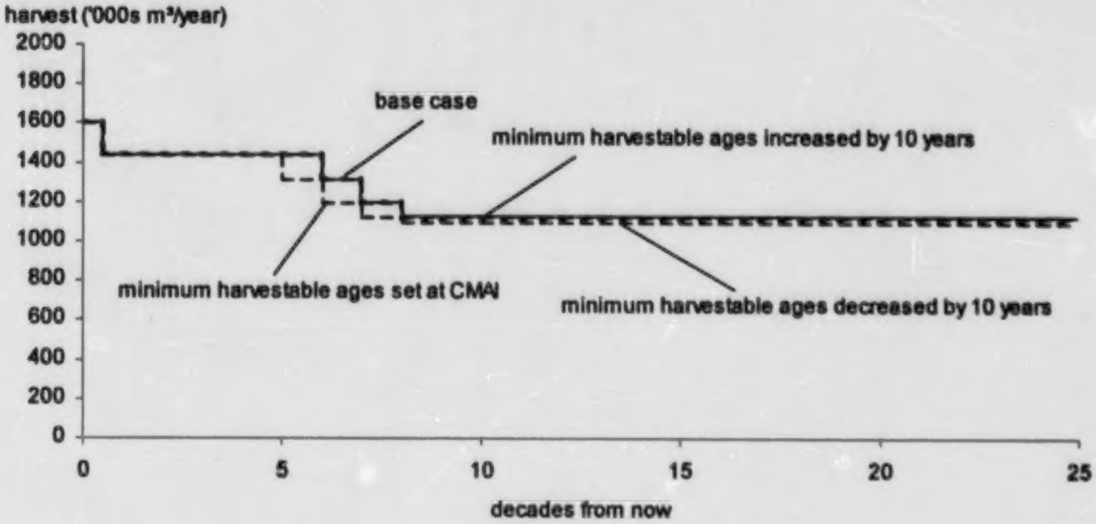


Figure 23. Harvest forecasts if minimum harvestable ages are younger or older than the base case — Merritt TSA, 2001.

Figure 23 also shows the timber supply impacts if minimum harvestable ages are changed to the culmination age. Since most existing unmanaged stands (60%) are currently older than minimum harvestable ages, changing minimum harvestable ages mainly affects regenerating stands. Changing the minimum harvestable ages to the culmination age increases managed stand minimum harvestable ages by 10 to 40 years, depending on the type of regenerated stand. Managed stands are important to timber supply during the transition of harvesting from old growth to second growth. As a result, when existing older stands are unavailable for harvest during the transition period, there are not as many regenerating stands old enough to be harvested under this management regime as there are in the base case. Thus, the decline to the long-term harvest level must occur a decade sooner than in the base case to avoid future timber supply disruptions. However, the long-term harvest level is increased by a small amount (1%) because stands are harvested closer to the age of maximum growth rate.

These results demonstrate that minimum harvestable ages are not highly limiting factors in the base case. If they were, timber supply over the first several decades of the harvest forecast would change in the opposite direction to the change in harvestable ages. For example, lower minimum harvestable ages could mean that second growth would be available sooner, therefore enabling faster harvest of existing stands. However, in the Merritt TSA the ages are not limiting because the base case long-term harvest level was set near the highest achievable level, so that many stands are projected to be retained until well after their minimum harvestable ages, and harvested nearer to the age of maximum average yield. Larger changes to the minimums, as in the CMAI run, change mid-term timber supply, but again do not affect the long term because the base case long-term harvests occur, on average, reasonably close to the culmination ages.

5.9 Alternative harvest queue rules

In the base case, the highest priority for harvest is given to stands that are oldest relative to their minimum harvestable age. This 'relative oldest first' rule is applied only after other requirements and priorities (e.g., forest cover requirements) are taken into account. This rule reflects the practice of favouring older stands, but not necessarily the oldest, for harvest when all other considerations have been met.

Besides the relative oldest first rule, the Forest Service Simulator (FSSIM) model permits use of absolute oldest first, absolute youngest first or random scheduling rules. These other rules may better reflect practices in some instances, given unforeseeable operational constraints that may affect when stands are chosen for harvest. Figure 24 shows how potential harvest levels are affected by changing the way stands are prioritized for harvest.

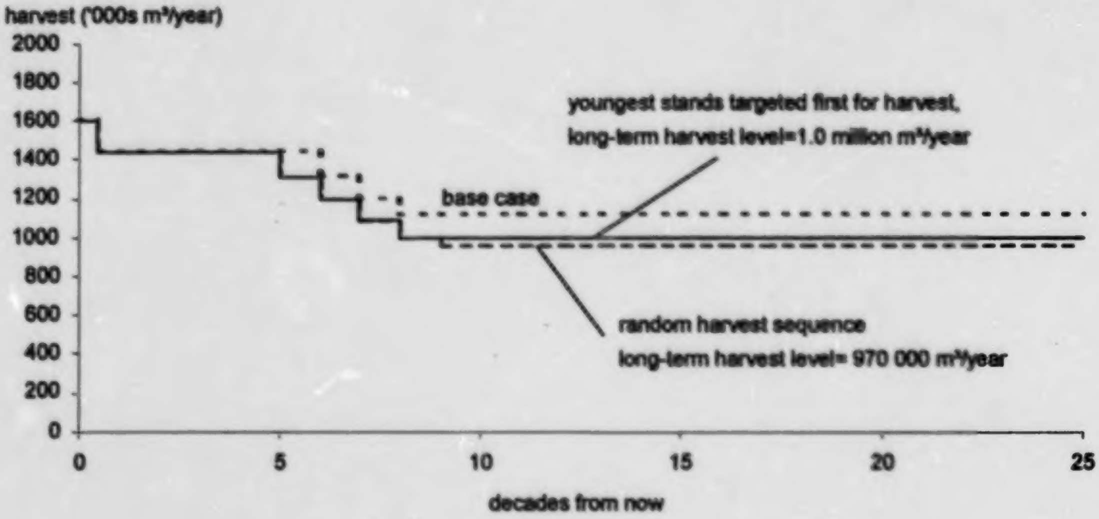


Figure 24. Effects of alternative harvest queue rules — Merritt TSA, 2001.

The 'random harvest scheduling' rule chooses stands that are older than the minimum harvestable age in a random order for harvesting, whereas the 'absolute youngest first' harvest rule schedules for harvest all stands above the minimum harvestable age simply by the stand age. If stands were ordered for harvest using the random harvest scheduling rule instead of the 'relative oldest first' rule, the decline to the long-term harvest level would have to occur one decade sooner than in the base case. In addition, the long-term harvest level would be decreased by approximately 13% to 0.97 million cubic metres per year. Similarly, if the 'absolute youngest first' harvest rule better reflected the way stands were chosen for harvesting, the decline to the long-term harvest level would again have to occur a decade earlier than in the base case. The long-term harvest level would be decreased by 11% to 1 million cubic metres per year. In both cases, average harvest age in the long term is significantly lower than in the base case.

5.10 Uncertainty in the application of landscape-level biodiversity requirements

The *Forest Practices Code of British Columbia Act* describes the conservation of biological diversity as an essential component of sustainable use of forests. The *Landscape Unit Planning Guide* (LUPG) provides recommendations for maintaining biodiversity at both the stand- and landscape-levels. As described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis," prescriptions for maintaining biodiversity at both the stand level and the landscape level were modelled in the base case. Stand-level biodiversity was addressed in this analysis by removing portions of each stand from the timber harvesting land base for wildlife tree patches, and by reducing stand volumes to reflect the retention of individual wildlife trees within cutblocks. Uncertainty about stand-level biodiversity can be assessed through the sensitivity analyses that examine the timber supply impacts of land base reductions and stand volume reductions.

Landscape-level biodiversity, however, was modelled in this analysis through the use of forest cover requirements applied to biogeoclimatic variants within each landscape unit. There is some uncertainty about how the recommendations in the *Landscape Unit Planning Guide* should be interpreted and the land base to which they are applied. The following sensitivity analyses provide an indication of the timber supply impacts associated with uncertainty about how the *Landscape Unit Planning Guide* seral distribution targets are applied in order to meet landscape-level biodiversity requirements.

Landscape units in the Merritt TSA are still in draft form, and assignment of lower-, intermediate- or higher-biodiversity emphasis to specific landscape units has yet to be finalized. Therefore, in the base case, old-seral* requirements for each landscape unit-variant combination were modelled using a single weighted constraint based on the anticipated distribution of 45% lower, 45% intermediate and 10% higher, biodiversity emphasis. The low emphasis portion the old-growth forest cover requirement is phased in over time, with the full requirement applied after 160 years (to provide time for the forest to age so that the old-seral requirement will be achieved by the end of 3 rotations, or 240 years from now).

Old seral
Old seral refers to forests with appropriate old forest characteristics which provide for biodiversity. Ages vary depending on forest type and biogeoclimatic variant.

5 Timber Supply Sensitivity Analyses

A number of analyses were conducted to test the base case harvest forecast for sensitivity to management for landscape-level biodiversity. Figure 25 shows that requiring the full old-growth requirement for the low-emphasis portion of the constraint has very little effect on timber supply (see Appendix A.4.9.1, "Forest cover requirements — landscape-level biodiversity." The long-term harvest level is decreased by approximately 1%, because in order to meet the slightly more stringent requirements for old growth, a small amount of older stands on the timber harvesting land base must be reserved from harvest. There is still ample timber of harvestable age on the timber harvesting land base to maintain harvest levels in the short- and medium-term, but those stands are harvested at slightly younger ages due to the reduced availability of older stands. As a result, long-term volumes harvested from these stands are slightly lower than in the base case.

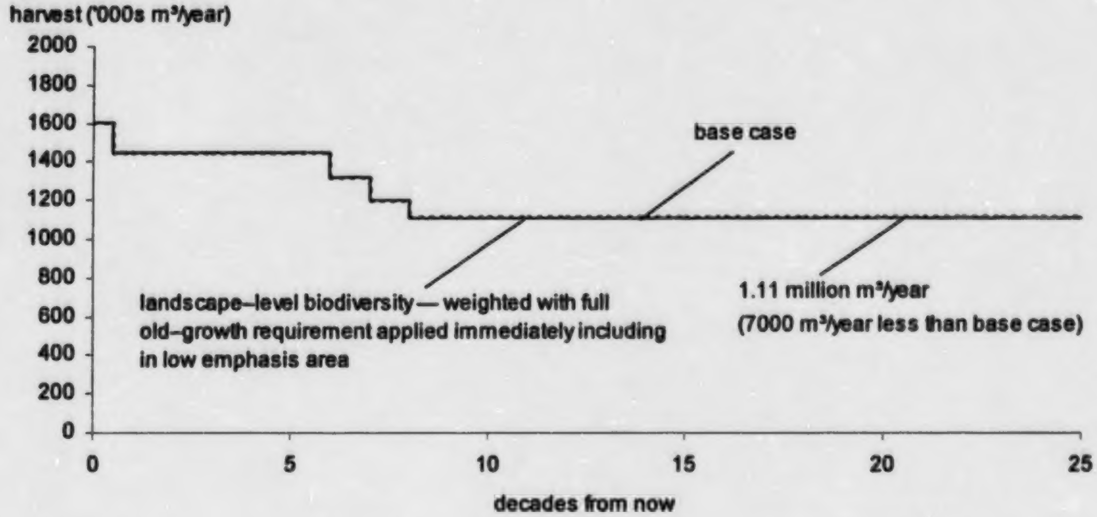


Figure 25. Harvest forecasts if landscape-level biodiversity assumptions are changed— Merritt TSA, 2001.

5 Timber Supply Sensitivity Analyses

Figure 26 shows the results of a sensitivity analysis that assessed the timber supply implications of applying landscape-level biodiversity requirements according to the draft biodiversity emphasis options (BEO) applicable to individual landscape units for the Merritt TSA. Analysis shows that applying both landscape unit-specific emphasis options, and the full old-growth requirement within landscape unit/variants with a low biodiversity emphasis option (i.e., no phase-in) has virtually no impact on timber supply.

In addition, Figure 26 shows the impact of requiring the maintenance of mature forest as well as older forest as outlined in the *Landscape Unit Planning Guide*. In this case, medium-term timber supply is decreased slightly because the mature forest requirement limits the availability of stands that are over minimum harvestable age but under the old forest age. In the base case, these stands are a source of timber during the transition of harvesting from old-growth to second-growth. Figure 26 also shows that adding requirements for young forest in addition to mature- and old-forest has no impact beyond that of adding the mature requirements. These sensitivity analyses show that, in the context of draft landscape units and biodiversity emphasis options, requirements for young forests do not limit timber supply in the Merritt TSA. However, requirements for mature and old forests do affect timber supply in the medium- and long-term.

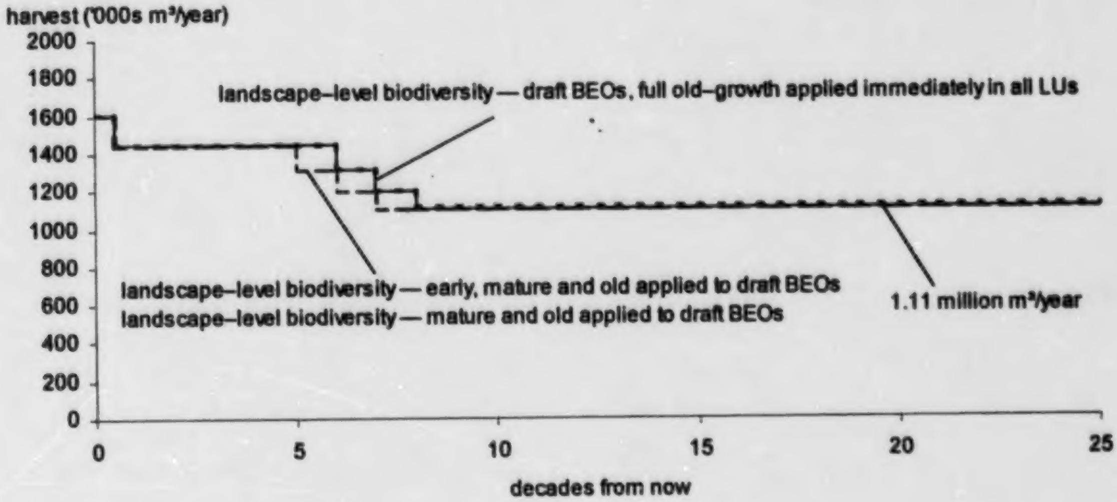


Figure 26. Harvest forecasts if landscape-level biodiversity assumptions are changed in the context of draft biodiversity emphasis options — Merritt TSA, 2001.

For the base case harvest forecast, it was assumed that forests outside the timber harvesting land base (non-contributing forests or non-timber harvesting land base) will continue to age over time so that, eventually, all non-contributing stands are older than 250 years. Since non-contributing forests will likely be subject to at least some natural disturbance, the degree to which old-seral requirements for landscape-level biodiversity are forecast to be met by these forests may be unrealistic. An alternative approach would be to assume that a proportion of non-contributing forests would be disturbed each year. For this sensitivity analysis, it was assumed that 400 hectares of non-contributing forest would be disturbed annually. Figure 27 shows that at that rate of disturbance in the non-timber harvesting land base, the long-term harvest level would be decreased by 5%. There is less timber supply in the long term compared to the base case because if there are fewer old stands in the non-timber harvesting land base, additional portions of the timber harvesting land base must be maintained in older forest to meet landscape-level biodiversity requirements.

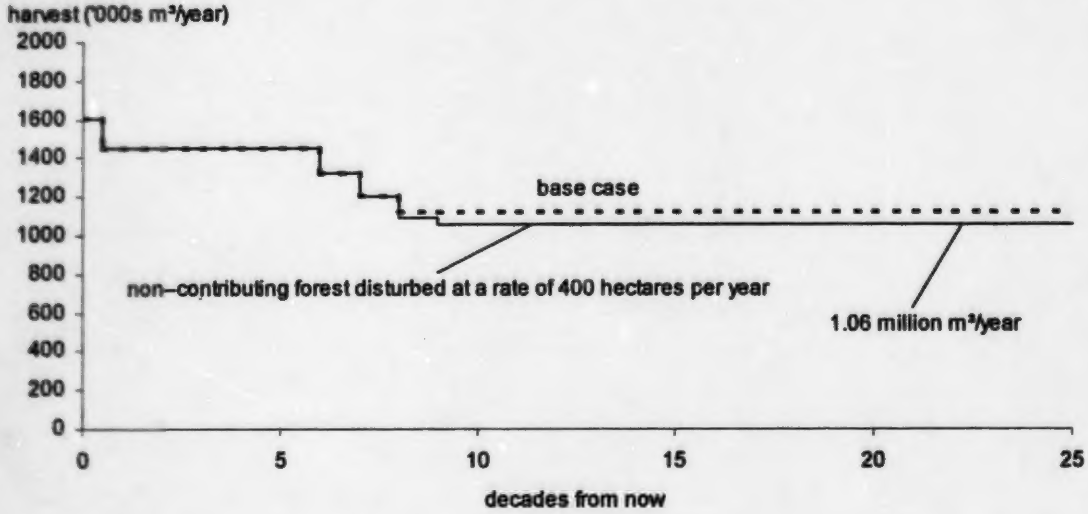


Figure 27. Harvest forecasts if 400 hectares of non-contributing forest is disturbed annually— Merritt TSA, 2001.

5 Timber Supply Sensitivity Analyses

Figure 28 shows the timber supply impacts of removing all provisions for biodiversity, both at the landscape level and at the stand level. This sensitivity analysis shows that requirements for biodiversity provisions as they have been modelled in the base case do not have an impact on short-term timber supply. However, without biodiversity requirements, the decline to the long-term harvest level can be delayed by an additional decade, and the long-term harvest level is increased by approximately 3% to 1.15 million cubic metres per year. Most of the impact on the long-term harvest level (approximately 2% of the total 3%) is the result of removing stand-level biodiversity requirements. Although wildlife tree patches contribute to landscape-level biodiversity, their contribution is relatively small (1.9% of the timber harvesting land base). Therefore, the effects of stand- and landscape-level biodiversity should be approximately additive, and it is estimated that the only impact of landscape-level biodiversity as modelled in the base case has is a 1% reduction in the long-term harvest level.

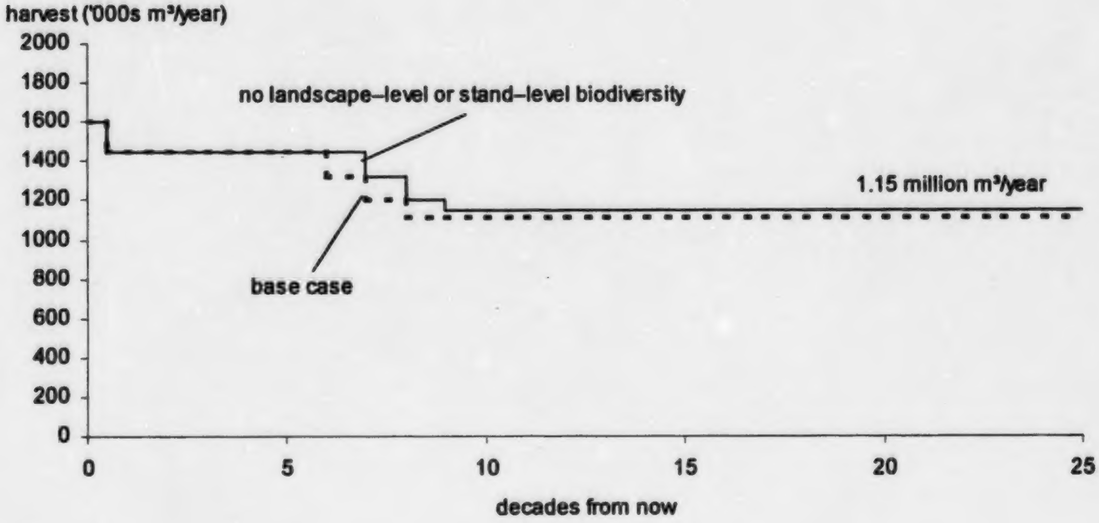


Figure 28. Harvest forecasts if there are no provisions for landscape-level or stand-level biodiversity — Merritt TSA, 2001.

5.11 Uncertainty in the merchantability of Douglas-fir stands

In the base case, both dry site Douglas-fir stands (selection management) and wet site Douglas-fir stands are included in the timber harvesting land base. The selection management stands occupy approximately 15% of the timber harvesting land base; approximately 4% of the timber harvesting land base is covered by wet site Douglas-fir. There is some uncertainty about the merchantability of Douglas-fir stands in the Merritt TSA, and to address this uncertainty, sensitivity analysis was undertaken to explore the timber supply implications if no harvesting occurs in these stands.

Figure 29 shows that if all Douglas-fir stands are removed from the timber harvesting land base, the decline to the long-term harvest level must occur 4 decades earlier than in the base case. In addition, the long-term harvest level is decreased by almost 10% to 1.02 million cubic metres per year. Removing Douglas-fir stands from the timber harvesting land base has an impact on the long-term harvest level that is disproportionate to its contribution to the timber harvesting land base (19%) because the selection management stands contribute a relatively small proportion of timber when they are harvested.

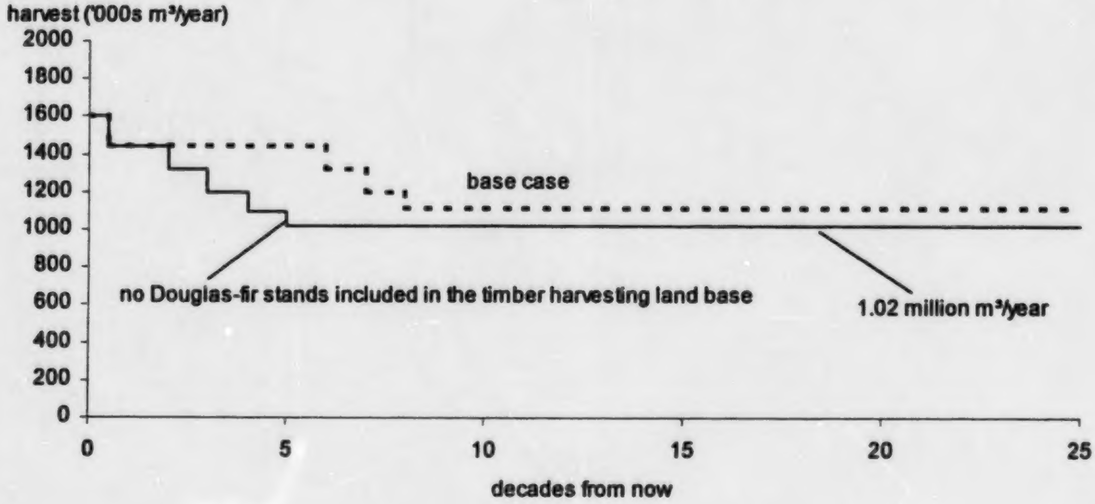


Figure 29. Harvest forecast if all Douglas-fir leading stands are excluded from harvesting — Merritt TSA, 2001.

5.12 Uncertainty in the size of the timber harvesting land base — proposed protected areas

There are several proposed protected areas* in the Merritt TSA. Since Cabinet has not yet confirmed their status as protected areas, they were considered part of the timber harvesting land base in the base case harvest forecast. These areas represent approximately 5% of the timber harvesting land base.

Figure 30 shows the timber supply implications of removing these proposed protected areas from the timber harvesting land base. The decline to the long-term harvest level would have to occur one decade earlier than in the base case, and the long-term harvest level would be decreased by approximately 4% to 1.07 million cubic metres per year.

The impact on timber supply is smaller than expected given the size of the decrease in the timber harvesting land base, since the proposed protected areas consist of stands that are producing less volume on average. While approximately 38% of the timber harvesting land base consists of stands on sites classified as good or medium quality, only 20% of the proposed protected areas are considered good or medium quality sites. There is also a much larger proportion of selection management stands (29% compared to 15% for the timber harvesting land base). Therefore, removal of proposed protected areas from the timber harvesting land base does not proportionately decrease the volume of timber that can be harvested over time. In addition, even if these areas were removed from the timber harvesting land base, they still contribute to requirements for older forest, thereby relieving some of the constraints on the remainder of the timber harvesting land base.

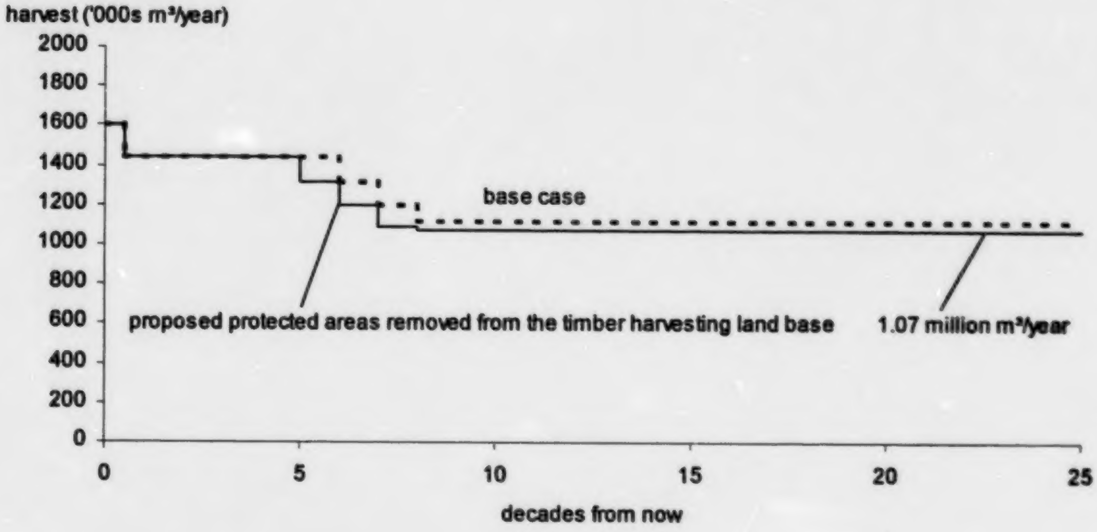


Figure 30. Harvest forecast if all proposed protected areas are excluded from the timber harvesting land base — Merritt TSA, 2001.

Protected area
A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).

5.13 Sensitivity analyses that had no impact on the base case timber supply

Two of the sensitivity analyses performed to assess uncertainty had no impact on the base case harvest forecast.

One of the areas of uncertainty examined for this analysis was whether or not timber supply would be affected if harvesting in pine-dominated stands were a priority. A large portion of the timber harvesting land base of the Merritt TSA is comprised of pine-dominated stands (56%, not including smallwood pine stands). Most (62%) of these pine stands are mature. Many of these stands are potentially susceptible to mountain pine beetle infestation. To assess the timber supply implications of focussing harvesting in pine stands in response to a potential infestation, a sensitivity analysis was conducted with a priority placed on pine stands for the first 50 years of the planning horizon. Placing a priority on pine stands caused mature pine stands to be harvested before any other mature stands, regardless of age. While the emphasis on harvesting pine stands would affect the types of timber volumes being harvested over time and the overall structure of the forest for the first 100 years of the planning horizon, there would be no impact on the volumes of timber that could be harvested through time.

Another area of uncertainty examined in this analysis was the amount of disturbance allowed in the standard management zone. *The Forest Practices Code* (FPC) requires that trees in a harvested area must reach a specific green-up height before adjacent areas are harvested. To ensure that harvesting-related disturbance does not become overly concentrated in any area, a maximum limit was set in this analysis on the overall area that has not reached the green-up conditions. In the base case, it was assumed that at most, 33% of the timber harvesting land base within the standard management zone in each landscape unit could be covered by stands less than 3 metres tall. These forest cover requirements are used in the analysis to approximate adjacency requirements. These requirements have some uncertainty because they are approximations of the effects of cutblock-level decisions and it is difficult to define the exact forest structure needed to meet the adjacency objectives for a particular area. Furthermore, there is uncertainty about how adjacency requirements will be implemented in the field. To address this uncertainty, the maximum allowable disturbance in the standard management zone was decreased to 25%. This had no impact on the base case. The adjacency requirements applied in the base case do not limit timber supply; rather, harvest levels in the standard management zone are determined more by the need to allocate existing inventory over time to achieve a stable timber supply projection, and requirements for landscape-level biodiversity. Therefore, making these green-up requirements more stringent than in the base case has no impact on timber supply, to a certain extent. The maximum allowable disturbance level could be decreased to 19% without having any impact on the harvest forecast.

6 Summary and Conclusion of the Timber Supply Analysis

The results of this timber supply analysis suggest that the Merritt TSA pre-uplift harvest level can be maintained for the next 6 decades, followed by a decline of 9% per decade for the following three decades to a sustainable long-term harvest level of 1.12 million cubic metres per year. This forecast is based on current inventory and timber growth information, and incorporates applicable forest management objectives for biodiversity, wildlife, community watersheds, visual quality, and riparian protection.

The base case results reflect current knowledge and information on forest inventory, growth and yield, and management. However, uncertainties about several factors important in defining timber supply have the potential to affect the harvest flow to varying degrees. Overall, the short-term timber supply in the Merritt TSA is insensitive to the areas of uncertainty examined in this analysis.

None of the changes to assumptions used in the sensitivity analyses resulted in a disruption of short-term timber supply. Because of the abundance of timber of harvestable age, changes in inventory assumptions, growth and yield, and management affected only either the timing of the decline to the long-term harvest level, the long-term harvest level itself, or both.

The medium- and long-term timber supply is significantly sensitive to changes to the timber harvesting land base. If the timber harvesting land base has been overestimated by 10%, then the decline to the long-term harvest level must occur 2 decades sooner than in the base case, and the long-term harvest level is decreased by 9%. If the timber harvesting land base has been underestimated by 10%, then the decline could take place 30 years later than in the base case, and the long-term harvest level would be 7% higher. If proposed protected areas are removed from the timber harvesting land base, the decline to the long-term harvest level must take place a decade sooner than in the base case and the long-term harvest level would be decreased by 4%. If all Douglas-fir dominated stands were removed from the timber harvesting land base, the decline to the long-term harvest level would have to occur after only 2 decades, and the long-term harvest level would be decreased by 10%.

Uncertainty associated with estimates of stand volumes also has a significant impact on timber supply. If existing stand volumes are increased by 10%, the decline to the long-term harvest level can be delayed an additional 4 decades compared to the base case without causing future disruptions in timber supply. Similarly, if existing stand volumes are decreased by 10%, the decline to the long-term harvest level must occur 5 decades sooner. Changes to estimates of managed stand volumes affect long-term timber supply proportionately. For example a 10% increase or decrease in the base case yields would, respectively, increase or decrease the long-term harvest level by 10%. If old-growth site indices (OGSI) have been underestimated to the extent indicated by provincial *Old Growth Site Index* studies, the long-term harvest level may be underestimated by 15%. In addition, the decline to this increased long-term harvest level could be delayed by an additional 11 decades compared to the base case. Analysis showed that possible underestimation of the productivity of smallwood pine sites after harvest may have resulted in underestimation of the long-term harvest level by as much as 8% compared to the base case

Timber supply in the medium- and long-term is also sensitive to harvest scheduling rules. If the youngest stands above minimum harvestable age were given priority for harvest, the decline to the long-term harvest level would have to occur a decade sooner than in the base case. In addition, the long-term harvest level would be 11% lower than if relatively oldest stands were given harvest priority. Similarly, if merchantable stands were selected randomly for harvest, the decline to the long-term harvest level would have to occur one decade sooner than in the base case, and the long-term harvest level would be decreased by 13%.

Other areas of uncertainty examined had a very small impact on timber supply. These include uncertainty about: green-up ages, minimum harvestable ages, landscape-level biodiversity requirements, green-up requirements for standard management areas, and priorities for harvest of pine stands. For these areas of uncertainty the timber supply impacts did not exceed 5% of the long-term harvest level, and affected the decline to the long-term harvest level by a maximum of one decade.

In conclusion, this analysis indicates that based on current inventory and growth and yield information, and the current management practices, timber harvesting in the Merritt TSA does not have to decline from the pre-uplift harvest levels until 60 years from now. Following 3 decades of decline at a rate of 9% per decade, the long-term harvest level of 1.12 million cubic metres per year is projected to be reached 9 decades from now. The analysis indicates that several factors related to the current forest inventory and management regime could affect timber supply in the medium- and long-term, but that short-term timber supply is stable.

6 Summary and Conclusion of the Timber Supply Analysis

Table 4. Summary of sensitivity analyses, Merritt TSA, 2001.

	Impact on harvest forecast relative to the base case		
Sensitivity analysis	**Short term**	**Timing of the decline to the long-term harvest level**	**Long-term harvest level**
Timber harvesting land base decreased by 10%	None	2 decades less at pre-uplift level	9% lower than base case
Timber harvesting land base increased by 10%	None	3 decades more at pre-uplift level	7% higher than base case
Green-up ages increased by 5 years	None	None	Less than 1% lower than base case
Green-up ages decreased by 5 years	None	None	None
Volume estimates for existing stands increased by 10%	None	4 decades more at pre-uplift level	None
Volume estimates for existing stands decreased by 10%	None	5 decades less at pre-uplift level	None
Volume estimates for regenerated stands increased by 10%	None	None	10% higher than base case
Volume estimates for regenerated stands decreased by 10%	None	None	10% lower than base case
Old-growth site index adjustments applied to managed stands	None	11 decades more at pre-uplift level	15% higher than base case
Site index adjustments applied to smallwood pine sites after regeneration	None	None	8% higher than base case
Minimum harvestable ages increased by 10 years	None	None	Less than 1% higher than base case
Minimum harvestable ages decreased by 10 years	None	None	1% lower than base case
Minimum harvestable ages set at CMAI	None	1 decade less at pre-uplift level	Less than 1% higher than base case
Harvest rule — absolute youngest first	None	1 decade less at pre-uplift level	11% lower than base case
Harvest rule — random	None	1 decade less at pre-uplift level	13% lower than base case
100% of old-seral requirements met immediately	None	None	1% lower than base case
100% of old-seral requirements met immediately and draft biodiversity emphasis options applied	None	None	1% lower than base case
Mature and old seral requirements applied using draft biodiversity emphasis options	None	1 decade less at pre-uplift level	1% lower than base case

(continued)

Table 4. Summary of sensitivity analyses, Merritt TSA, 2001 (concluded).

Sensitivity analysis	**Impact on harvest forecast relative to the base case**		
	Short term	**Timing of the decline to the long-term harvest level**	**Long-term harvest level**
Early, mature and old seral requirements applied using draft biodiversity emphasis options	None	1 decade less at pre-uplift level	1% lower than base case
Non-contributing forest disturbed at a rate of 400 hectares per year	None	None	5% lower than base case
No landscape- or stand-level biodiversity applied	None	1 decade more at pre-uplift level	3% higher than base case
Douglas-fir stands unavailable for harvest	None	4 decades less at pre-uplift level	10% lower than base case
Proposed protected areas excluded from timber harvesting land base	None	1 decade less at pre-uplift level	4% lower than base case
Harvest priority on pine stands	None	None	None
Disturbance in standard management zone limited to 25%	None	None	None

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the timber supply review. This socio-economic analysis compares the level of forestry activity currently supported by timber harvested from the Merritt TSA with the level of activity that could be expected given the timber supply projections over the long term.

The socio-economic analysis examines the short- to long-term harvest levels as projected in the base case harvest forecast. The base case is intended to reflect current forest management practices; consequently, the socio-economic analysis does not evaluate alternative management scenarios.

The socio-economic analysis includes:

- a profile of the current socio-economic setting;
- a description of the Merritt TSA forest industry; and
- an analysis of the socio-economic implications of the base case harvest forecast.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Merritt TSA within the context of regional timber supplies and production capacity. It does this by examining the profile of the region and the local forest industry; and by undertaking a socio-economic analysis using the harvest forecasts as projected in the base case.

The socio-economic analysis includes an estimate of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and woodlands related activities, processing, and silviculture. Employment is measured in terms of person-years*. Employment income is calculated using average industry income estimates.

Data on direct employment, harvest levels, and fibre flows were obtained by surveying licensees and mill operators. The information was used to estimate harvesting, processing and silviculture direct employment averages associated with the harvest and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing, and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Indirect and induced employment were calculated using the Merritt TSA and provincial employment multipliers* developed by the Ministry of Finance and Corporate Relations. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients* per 1000 cubic metres were also determined for these indirect and induced imports.

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current productivity, harvest practices and management assumptions* and will not likely reflect industry conditions decades into the future. As such, the employment estimates should only be viewed in a general way.

Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

Employment multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Employment coefficient
The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Management assumptions
Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

7 Socio-Economic Analysis

7.1 Current socio-economic setting

7.1.1 Overview

The socio-economic analysis focuses on the timber supply from the Merritt TSA, located in south-central B.C. which covers approximately 1.1 million hectares. However, the TSA is part of the larger Merritt Forest District. The forest district includes parks and a number of woodlots. Since communities are located throughout the district and employment is not easily separated between the TSA and woodlots, this section profiles the forest district instead of the TSA.

7.1.2 Population and demographic trends

According to the 1996 Census, between 1991 and 1996 the population of the Merritt Forest District increased by 12% to roughly 16,830 people. In comparison, the population of the province increased by 14% over the same period. The population of the Merritt Forest District decreased through the first half of the 1980s, but has had positive growth more recently. The population of the TSA is concentrated in the city of Merritt (1996 population of 7,940) and the town of Princeton (2,932). By 2005, the population of the district is expected to grow to approximately 18,700.[1]

7.1.3 Economic profile

Situated about 200 kilometres east of Vancouver, the Merritt TSA encompasses the hub of the Coquihalla highway system providing the northern TSA with direct links to the Lower Mainland in less than three hours, to Kamloops in 45 minutes, and to Kelowna and the Okanagan Valley in 75 minutes. In the southern part of the TSA near Princeton, Highway 3 provides good access to the Lower Mainland and the Okanagan Valley. Since the completion of the Coquihalla in 1990, the area's economy has become more diversified, particularly with growth in the tourism, recreation, and transportation sectors.

Influxes of new residents, relocating primarily from urban areas, are mainly attracted by lifestyle considerations and low housing costs. The unemployment rate in this south-central portion of the province was between 9–10% in 1999, slightly higher than the provincial average of 8.3%. Building permits in the city of Merritt (January to September) were valued at $11 million in 2000, up from $4 million in 1999.

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(1) B.C. Stats. Population Section.

7 Socio-Economic Analysis

The Merritt TSA, although not heavily homogeneous and/or single industry dependent is also not well diversified. Forestry, the traditional underpinning of the local economy, encompasses both primary and secondary production. Recently, relatively smaller operations taking advantage of value-added opportunities are assuming greater importance, producing niche products such as log homes and specialized furniture types. The major mills however account for the bulk of TSA employment. About 25% of residents' total after tax income is derived from forest-based employment.[2]

Ranching is another important part of the local economy. A significant number of ranches are in operation in the Nicola Valley including the Douglas Lake Ranch, one of the largest ranches in North America. Increasingly ranches are diversifying their operations to encompass a variety of new ventures ranging from ginseng to greenhouses, buffalo, and fallow deer. Also, tourism plays an increasing role, with ranches providing guesthouses, trail riding, trophy fishing and shops for visitors. Ranching is one the mainstays of the Princeton economy with over 30 ranches operating in the area.

Over the last decade tourism has grown to become a major part of the local economy. Visitors are drawn to the Merritt TSA for its outdoor recreation and climate. Tourist activities include mountain biking, fishing, golfing, sailing, camping, hiking, hunting, riding, cross-country skiing, and snow-mobiling. The Kettle Valley Railway rail-bed passes through the area and offers unique opportunities for both short and extended hiking and mountain-biking excursions. Tourism is expected to remain a high growth sector of the economy over the next decade. Film industry activity is also steadily increasing in the area.

Like many B.C. communities, coal played a major role in Merritt's early development. Currently, a number of mines operate in the region including Highland Valley Copper, one of the largest open pit mines in the world. The Craigmont Mine tailings are being re-worked to obtain minerals previously unrecovered. There has also been some new exploration activity in the area. The mining sector remains a significant aspect of the local economy, despite its recent slow growth and current depressed prices.

In the northern part of the TSA, the city of Merritt is the service centre for the Nicola Valley, providing most retail, commercial, and professional services for both the community and the surrounding area. In addition, the city's location on the Coquihalla Highway, has led to an expansion in the range of services directed at tourist and transient traffic. In the southern TSA, Princeton is a retail and service centre for the local area.

Figure 31 illustrates the shares of total employment by industry sector for the Merritt Forest District.

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(2) The 1996 Forest District Tables, April 1999, Ministry of Finance and Corporate Relations.

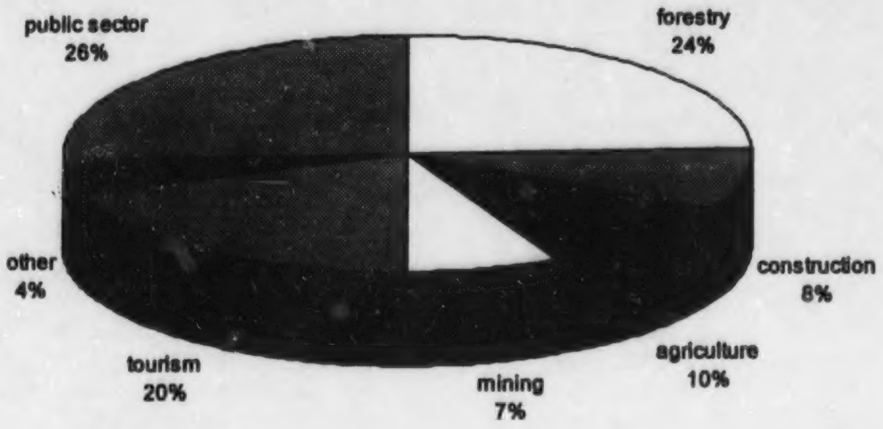

Figure 31. Estimates of total employment by sector, Merritt Forest District, 1996.

Notes: 'Forestry' consists of harvesting related activity and manufacturing. 'Other' consists of finance, insurance, real estate and other business services. 'Public Sector' consists of local and provincial government, health and education.
Source: The 1996 Forest District Tables (April 1999) / Ministry of Finance and Corporate Relations.

The forest sector supports numerous other jobs in the region through companies and employees purchasing goods and services from local businesses. This spending is another indicator of the role of forestry in the economy. Each 100 direct forestry jobs in the Merritt TSA are estimated to support a further 20 to 40 indirect and induced jobs*[3], depending on the type of forestry activity (logging or processing) and the associated level of income. In comparison, each 100 public sector jobs support 10 to 20 additional positions, while each 100 tourism jobs support approximately six to 13 positions.

Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

7.2 Merritt TSA forest industry

7.2.1 Current allowable annual cut

In 1996, the chief forester set the allowable annual cut (AAC) for the Merritt TSA at 1 454 250 cubic metres, which included a partition of 250 000 cubic metres for harvesting small-diameter stands. The AAC was increased to 2 004 250 cubic metres, effective January 1999, which includes a temporary increase of 550 000 cubic metres for the salvage of fire- and insect-damaged stands, and continues the 250 000 cubic metre partition for small-diameter stands.

Five companies (Weyerhaeuser, Tolko, Riverside, Aspen and Ardew) have replaceable forest licences, and the remainder of the volume is apportioned to the Small Business Forest Enterprise Program (SBFEP) and to smaller timber sale licences. The current AAC of 2 004 250 cubic metres is apportioned by the Minister of Forests as outlined in Table 5.

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(3) Ibid.

Table 5. Allowable annual cut apportionment, Merritt TSA

Licence type	Volume m^3/year	Per cent (%)
Forest licences — replaceable	1 025 694	51.2
Forest licences — non-replaceable	212 500	10.6
Small Business Forest Enterprise Program (SBFEP) — all categories	180 738	9.0
Woodlot licences	9 200	0.5
Forest service reserve[a]	576 118	28.7
Total AAC	2 004 250	100.0

Source: Ministry of Forests, 2001.

(a) Currently includes the uplift volume of 550 000 cubic metres per year.

7.2.2 Merritt TSA harvest history

The actual annual harvest level is an important indicator of forestry activity in the timber supply area. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year indicates the economic activity supported by the timber supply area.

Based on billed volumes from 1996–1999, an average of about 1 424 218 cubic metres of crown timber was harvested annually in the Merritt TSA. Additional (non-TSA) sources of timber include private lands, woodlots and Indian reserves, which amounted to approximately 70 000 cubic metres per year over the same period.

Table 6 summarizes the volume of timber harvested in the Merritt TSA from 1996 to 1999. It indicates a fairly steady level from 1996 to 1998. Then in 1999, there is a sharp increase in the volume due to cut-control[4] requirements and the temporary AAC uplift for the salvage of insect- and fire-damaged stands.

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(4) A licensee's actual harvest level may differ from their licence AAC by up to 50% annually, however the total must be within 10% by the end a five-year period.

Table 6. Merritt TSA volumes billed, by licence type, 1996-1999.

Tenure	Cubic metres (m^3)				
	1996	**1997**	**1998**	**1999**	**Average 1996-1999**
Forest Licences	998 488	909 861	969 264	1 610 781	1 119 349
Small Business Forest Enterprise Program (SBFEP)	104 917	145 018	110 464	122 460	120 715
Other[a]	79 572	102 351	132 229	422 465	184 154
Total	1 171 977	1 157 230	1 211 957	2 155 706	1 424 218

Source: Ministry of Forests.

(a) Other consists of the Ministry of Forests' Forest Service Reserve and other smaller permits.

The Merritt TSA AAC harvest makes up about 15% of the total harvest in the Kamloops Forest Region (8.8 million cubic metres) while the region, in turn, accounts for about 12% of the total provincial harvest (71 million cubic metres).

7.2.3 Merritt TSA major licensees

Weyerhaeuser Company Limited

Weyerhaeuser Company Limited (Weyerhaeuser) has a replaceable forest licence providing the rights to harvest 568 556 cubic metres per year in the Merritt TSA. In B.C., Weyerhaeuser is the largest licence holder with a total of over 7.0 million cubic metres per year.

Weyerhaeuser Company Limited is a wholly-owned subsidiary of Weyerhaeuser Company, one of the world's largest integrated forest products companies. In Canada, Weyerhaeuser made its first investment in 1965, and now Canadian operations account for a significant share of Weyerhaeuser's North American activities. In November 1999, Weyerhaeuser expanded their operations in B.C. by the purchase of MacMillan Bloedel.

Weyerhaeuser operates four sawmills in British Columbia's southern interior including facilities at Princeton (Merritt TSA), Okanagan Falls (Okanagan TSA), Vavenby and Kamloops (Kamloops TSA). The Princeton operation has an annual capacity of 165 million board feet of lumber and employs about 160 people, while the Okanagan, Vavenby and Kamloops facilities employ another 520. Weyerhaeuser also operates a large pulp plant in Kamloops, which employs about 550 people. Their sawmill in Merritt was closed in 1999.

Table 7 outlines Weyerhaeuser's recent harvest activity and 1999 employment levels for its Merritt TSA operations.

Table 7. Weyerhaeuser harvest and 1999 direct employment statistics

Allowable annual cut (AAC)	568 556 cubic metres
1999 harvest	918 712 cubic metres
1996-1999 average harvest	606 870 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	300
Processing	336

Note: The employment figures relate to the volumes harvested from the Merritt TSA land base only.

Tolko Industries Limited

Tolko Industries Limited (Tolko) has a replaceable forest licence to harvest 268 954 cubic metres per year in the Merritt TSA. In addition, Tolko holds five other tenures throughout the province, amounting to about 1.5 million cubic metres per year. Table 8 outlines Tolko's recent harvest activity in the TSA and its 1999 employment levels for TSA operations.

Tolko is a private, family-owned company whose primary business is marketing and manufacturing of lumber and wood products. Founded in 1961, the company was originally incorporated as Lavington Planer Mill Ltd. Today, Tolko has expanded to eight manufacturing divisions and four marketing and sales divisions, with the corporate office located in Vernon, B.C.

Tolko operates a sawmill and chipping complex in Merritt with an annual capacity of just over 140 million board feet of lumber. The Merritt mill employs about 180 people and in 1999 utilized almost 500 000 cubic metres of timber. The company also operates a large plywood complex in Heffley, about 20 kilometres north of Kamloops, and a lumber mill in Louis Creek, another 50 kilometres north (both in the adjoining Kamloops TSA). These two plants employ an additional 400 people and in 1999 utilized another 750 000 cubic metres of timber.

Table 8. Tolko harvest and 1999 direct employment statistics

Allowable annual cut (AAC)	268 954 cubic metres
1999 harvest	303 631 cubic metres
1996-1999 average harvest	222 948 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	99
Processing	201

Note: The employment figures relate to the volumes harvested from the Merritt TSA land base only.

Aspen Planers Limited

Aspen Planers Limited (Aspen) has a replaceable forest licence to harvest 132 744 cubic metres per year in the Merritt TSA. Table 9 outlines the company's recent harvest activity in the TSA and its 1999 employment levels for TSA operations.

Aspen operates a lumber and planer mill, and a post and rail facility in Merritt. The post and rail facility produces untreated products, and the sawmill provides random-length lumber to both Canadian and export markets. The mill in Merritt can support about 130 manufacturing positions. Wood chips from the lumber operation support additional employment in Kamloops.

Table 9. Aspen harvest and 1999 direct employment statistics

Allowable annual cut (AAC)	132 744 cubic metres
1999 harvest	149 910 cubic metres
1996-1999 average harvest	119 594 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	49
Processing	133

Note: The employment figures relate to the volumes harvested from the Merritt TSA land base only.

Ardew Wood Products Limited

Ardew Wood Products Limited (Ardew) manages a replaceable forest licence allowing the harvest of 36 100 cubic metres of timber per year in the Merritt TSA.

Since incorporation in 1966, Ardew has been supplying the Japanese market with specialty wood products from the B.C. interior. Ardew's product base ranges from small knot pine for Canadian modular furniture manufacturers to premium structural components for the Japanese prefab housing industry.

Table 10 summarizes the harvest activity and employment associated with Ardew's operations in the TSA.

Table 10. Ardew harvest and 1999 direct employment statistics

Allowable annual cut (AAC)	36 100 cubic metres
1999 harvest	23 904 cubic metres
1996-1999 average harvest	34 600 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	8
Processing	85

Note: The employment figures relate to the volumes harvested from the Merritt TSA land base only.

Riverside Forest Products Limited

Riverside Forest Products Limited (Riverside), partially owned by Tolko industries, holds a replaceable forest licence to harvest up to 19 340 cubic metres per year in the Merritt TSA.

Riverside, Canada's leading producer of softwood plywood and veneer, and a major manufacturer of stud and random length lumber, supplies customers in North America, Japan and Europe. Riverside's manufacturing operations are located in the Okanagan TSA.

Table 11 summarizes the harvest activity and employment associated with Riverside's operations in the TSA.

Table 11. Riverside harvest and 1999 direct employment statistics

Allowable annual cut (AAC)	19 340 cubic metres
1999 harvest	16 035 cubic metres
1996-1999 average harvest	19 042 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	5
Processing	0

Note: The employment figures relate to the volumes harvested from the Merritt TSA land base only.

Small business, small-diameter stand, and other licensees

Other licensees in the Merritt TSA are mainly comprised of Small Business Forest Enterprise Program participants with an AAC apportionment of 180 738 cubic metres. The Forest Service Reserve (FSR) allows for the annual harvest of an additional 576 118 cubic metres (includes 550 000 cubic metres associated with the temporary uplift).

A total of 212 500 cubic metres per year are assigned to licences issued for the harvesting of small-diameter stands. These licence holders include Nicola Pacific Forest Products, Qwa'eet Forest Products, Princeton Wood Preservers Ltd./Hu'Kwa Resources Inc., Mego Wood Products Ltd., NMV Lumber Ltd. and the Princeton and District Community. In 1999 and 2000, these licences harvested 228 000 cubic metres and 240 295 cubic metres, respectively.

From 1996 to 1999, harvests from these other licensees (including incidental cutting permits), averaged 421 163 cubic metres annually, which supported roughly 400 direct harvesting, silviculture and processing person-years.

7.2.4 Forest sector employment summary

In this section, the preceding harvesting and employment information is considered in the development of employment coefficients used to project future employment levels. For this purpose, the forest sector has been divided into the following three sub-sectors:

- harvesting and other woodlands related employment such as log salvage and log scaling, and planning;
- silviculture activity including all planting and other basic and intensive operations; and
- primary timber processing employment.

Harvesting and silviculture employment

The harvesting sub-sector of the forest industry includes both company and contract loggers and is the most closely tied to the AAC. Consequently, harvest level changes will affect this sub-sector first, and in close to the same proportions.The silviculture sub-sector is less linked to the current level of harvest, since silviculture activities occur from one to six years after harvesting. Silviculture activity is divided into basic and enhanced work. Basic silviculture consists of surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive silviculture includes spacing, fertilizing, and pruning*. Since 1987, holders of forest licences are responsible for basic silviculture on areas harvested. The provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land, which is normally completed by silviculture contractors.

Primary timber processing employment

Processing facilities in the TSA rely on the Merritt TSA and other TSAs, tree farm licences (TFLs)*, woodlots, and private lands in the area for their timber supply. Timber from the Merritt TSA also helps to support processing plants located outside of the TSA — throughout the region and province.

Forest Service employment

The Merritt TSA is administered by staff working in the Merritt Forest District. Currently, 55 people work in the forest district office in Merritt, and another five at a field-office in Princeton. Forest Service staff administer and enforce statutory requirements associated with the *Forest Act*, the *Range Act* and the *Forest Practices Code*; and plan for the SBFEP in the Merritt TSA, and woodlots within the Merritt Forest District. Forest Service employment is not included in the forestry sector discussion regarding impacts; nonetheless these jobs are included in the public sector employment.

Merritt TSA forestry employment and employment coefficient summary

Table 12 summarizes employment supported by the 1996 to 1999 average harvest in the Merritt TSA, and the corresponding employment coefficients. The employment and coefficients are separated into two groups:

1) TSA employment and employment coefficients, which comprise residents of the Merritt TSA who are employed within the Merritt TSA; and
2) Provincial employment and employment coefficients, which comprise all forest sector employment in the province that relies on the Merritt timber supply, including both residents of the Merritt TSA and those who live elsewhere.

Calculations have been made for both groups to identify the importance of the forest sector within the Merritt TSA and to highlight the contribution that the Merritt TSA's forest sector makes to the provincial economy.

From 1996 to 1999, the average annual harvest from the Merritt TSA was 1.424 million cubic metres.

Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

Table 12. Employment and employment coefficients — Merritt TSA

Activity	TSA person-years	TSA coefficients	Provincial person-years	Provincial coefficients
Harvesting and silviculture	473	0.33	498	0.35
Processing	585	0.41	776	0.54
Total direct	1,058	0.74	1,274	0.89
Indirect / induced	306	0.21	1,733	1.22
Total employment	1,364	0.96	3,007	2.11

Note: Employment estimates are person-years based on average 1996–1999 employment levels and the average 1996–1999 harvest of 1.424 million cubic metres. Person-years do not indicate individual jobs. Wood products transport, and road building and maintenance are included in indirect estimates.

More detailed information regarding employment coefficients is presented in Appendix B, "Socio-Economic Analysis Background Information."

7.2.5 Merritt TSA employment income

From 1997 to 1999 the average annual income for direct forest sector employees was approximately $49,100 (depending on the type of forestry activity); and $30,600 for indirect and induced employment (in 1999 dollars). Based on these averages, current harvesting, silviculture, and processing of timber from the Merritt TSA generates an estimated $44.2 million in direct wages and salaries and $40.1 million in indirect and induced wages and salaries, annually throughout the province (see Table 13).

Table 13. Average annual direct and indirect/induced incomes and total employment income, 1996-

	Average annual income (1999 dollar value)	Total annual income ($ millions)	Total income ($/'000s m^3)
Direct	49,100	44.2	31,050
Indirect / induced	30,600	40.1	28,150
Total income		84.3	59,200

Source: Statistics Canada, Survey of Employment Payrolls and Hours.

7.2.6 Provincial government revenues

Provincial government revenues from the forestry industry include stumpage, royalties and rent payments; other taxes such as logging, corporate capital, sales, property and electricity taxes; and income taxes from direct, indirect and induced employees.

From 1996 to 1999 average stumpage and rent payments for Crown timber in the Merritt TSA were approximately $30.3 million per year. Forest and corporate taxes and revenues generated $10.6 million, while employment supported by the Merritt timber harvest accounted for $9.7 million in provincial income taxes (see Table 14).

Table 14. Average annual provincial government revenues, 1996–1999

	Average annual revenue 1996—1999 ($ 1999 millions)	Revenue ($/'000s m^3)[a]
Stumpage, rents and royalties	30.3	21,275
Industry taxes	10.6	7,450
Provincial income tax	9.7	6,800
Total government revenues	50.6	35,550

(a) Based on an average 1996-1999 harvest of 1 424 218 cubic metres per year.

7.3 Socio-economic implications of the base case harvest forecast

The base case harvest forecast projects a continuation of the pre-uplift AAC, less woodlots (1 445 550 cubic metres) for the next six decades. Then over the subsequent three decades the harvest level decreases to the steady long-term harvest level of 1.12 million cubic metres per year. The socio-economic analysis on the base case harvest level considers:

- the short- and long-term implications of alternative harvest levels for both the Merritt TSA and the province;
- possible impacts on the communities within the TSA;
- timber requirements of processing facilities within the Merritt TSA; and
- regional timber supply implications.

The socio-economic analysis considers the average levels of forestry activity that the base case harvest forecast could support, assuming that employment changes by the same percentage as the harvest level, and that the proportions of harvesting, processing, and silviculture employment remain the same. Since the analysis also assumes that the types and proportions of products manufactured remain constant, it does not attempt to predict how timber flows, technology or product lines may change in response. The analysis provides an indication of the magnitude of impacts to expect within a constantly changing socio-economic environment.

Employment and income impacts are divided into direct, indirect and induced components; the sum of all the components is the total impact. Direct impacts reflect harvesting, silviculture, and processing activity. Indirect impacts are the result of direct businesses purchasing goods and services, and induced impacts are the result of direct and indirect employees spending their incomes on consumer goods and services.

Table 15 estimates the range of impacts (changes) that the base case harvest forecast may have on employment and income. Ranges are utilized to reflect the availability of employment insurance and social assistance payments, and their mitigating effects in the shorter term. The lower end of the range reflects induced impacts which are diminished in the short term, because employment insurance and social assistance provide income support to any displaced workers (or, in the case of an increase in harvesting, workers considering moving to the TSA). The upper end of the range represents long-term impacts when displaced workers leave (or new residents enter) the area, and local spending patterns are more fundamentally affected. In reality, a combination of these two scenarios — some workers accessing social assistance payments, some finding alternate employment and some leaving the area completely (or entering) — is more likely to occur.

While this method is reasonably accurate for short-term forecasts (within the next five years), employment coefficients 20 years from now may be very different due to changes in market conditions, timber processing technologies, etc. The analysis provides an indication of the magnitude of impacts to employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

7.3.1 Short- and long-term implications of alternative harvest levels

Merritt TSA level employment and income impacts

For accounting purposes, the TSA employment and income include only workers who are supported by the TSA harvest and who reside within the TSA. Workers who come to the TSA to work but who reside outside the TSA are included in the provincial impact section, as is employment supported by Merritt TSA timber processed at mills outside the TSA. Table 15 indicates the employment and income that could be supported within the Merritt TSA by the base case harvest forecast.

The AAC for the Merritt TSA has been temporarily increased to 2 004 250 cubic metres per year since January 1999. This increase was an emergency measure to address the catastrophic impact of the mountain pine beetle infestation and the 1998 Tulameen Fire. Although the socio-economic analysis examined this harvest level, due to its temporary status, it was not used as a benchmark for assessing impacts from the base case harvest level. It examines the volumes recorded and billed during 1996-1999, which show an average harvest level of 1.424 million cubic metres per year that supports approximately 1,058 person-years of direct employment and another 306 indirect and induced person-years of employment within the TSA. This level of activity contributes approximately $43.0 million (1999 dollar value) of total after-tax annual local employment income.

The base case harvest forecast of 1 445 550 cubic metres per year, if fully harvested, would support approximately 1,074 person-years of direct local employment and 311 person-years of indirect and induced local employment, an increase of about 20 person-years. Total after-tax employment income would increase by approximately $0.6 million to $43.6 million per year.

Approximately 95% of all direct employees reside within the Merritt TSA. Changes to the Merritt harvest levels should be expected to have the greatest effect on the economies of Merritt and Princeton, where most of the processing activity is centred.

Provincial employment and income impacts

Provincial employment and income impacts include all forest sector employment supported by the timber harvested from the Merritt TSA, within the TSA as well as outside. Current harvest levels support about 1,274 person-years of direct forestry employment and a further 1,733 person-years of indirect and induced employment across the province. The forecasted timber supply of 1 445 550 cubic metres per year would increase total employment by about 45 person-years.

Provincial government revenue impacts

Based on current tax and stumpage rates, the current AAC of 2 004 250 cubic metres has provided approximately $70.8 million annually to the provincial government (1999 dollar value). Over 1996 to 1999, actual harvests contributed about $50.6 million annually. Under the base case forecast of 1 445 550 cubic metres, if fully harvested and utilized, the annual provincial government revenues could be about $51.3 million (assuming current taxation and stumpage rates do not change).

7 Socio-Economic Analysis

Table 15. Projected socio-economic impacts of the base case forecast — Merritt TSA

	Current AAC	Actual harvest levels (1996–1999)	Base case forecast 1–6 decades
Timber supply (m³/year)	2 004 250	1 424 218	1 445 550
Change from actual levels			+ 21 332
Merritt TSA			
Employment		person-years	
Direct	1,482	1,058	1,074
Indirect / induced	429	306	311
Total	1,911	1,364	1,384
Change in total person-years			(53) – 94
Net employment income		($1999 millions)	
Direct	50.1	35.8	36.3
Indirect / induced	10.1	7.2	7.3
Total	60.2	43.0	43.6
Change in total income			(1.1) – 2.4
Province (includes Merritt TSA)			
Employment		(person-years)	
Direct	1,785	1,274	1,293
Indirect / induced	2,428	1,733	1,759
Total	4,212	3,006	3,051
Change in total person-years			(237) – 327
Net employment income		($ 1999 millions)	
Direct	61.9	44.2	44.8
Indirect / induced	57.3	40.9	41.5
Total	119.2	85.1	86.3
Change in total income			(5.4) – 7.9
Provincial government revenues		($ 1999 millions)	
Provincial income tax	13.6	9.7	9.8
Stumpage and rent	42.4	30.3	30.7
Other B.C. revenues	14.8	10.6	10.7
Total B.C. revenues	70.8	50.6	51.3
Change in total revenue			0.1 – 1.4

Notes: Provincial employment includes both Merritt TSA employment and employment supported outside the TSA by Merritt TSA harvested timber. Income figures in Table 15 are net of taxes while those in Table 10 are gross income.

7.3.2 Community-level impacts

The impacts of short- and long-term changes in timber supply occur within a growing region. The more diversified the region the less effect changes in any one sector will have on the regional economy.

Given that the Merritt TSA forestry-related activities provide about 24% of the basic employment in the TSA, changes to the timber supply would be expected to have a fairly significant impact on the overall economic trends of the region. However, considering that the average 1996-1999 harvest levels were not significantly different than those projected in the base case, community-level impacts would likely be minimal if the base case levels are achieved.

7.3.3 Nature, production capabilities, and timber requirements of processing facilities

The milling requirements of the processing facilities in the Merritt TSA are about 1.49 million cubic metres per year (see Table 16); requirements that are not quite met by the timber harvested within the TSA. Since current harvest levels over the last few years are roughly the same as the base case forecast, this situation is unlikely to change. Nonetheless, declining timber supplies in other areas of the province may increase the demand for Merritt TSA timber by producers from outside the TSA.

7.3.4 Regional timber supply implications

From 1996 to 1999, the average total consumption of the TSA mills was 1.494 million cubic metres, 95% of which was harvested from TSA sources. Table 16 summarizes aggregate wood flow within the TSA over the period.

Table 16. Merritt TSA mill fibre supply (1996 – 1999)

	Cubic metres (m^3)	Per cent (%) of total
Total within TSA	1 424 218	95
Woodlots	12 445	1
Private and Indian reserves	57 279	4
From other TSAs	22	0
Total mill requirements	1 493 963	100

Source: Ministry of Forests.

In addition to the TSA timber supply, the future of the broader regional timber supply is also important to primary processing facilities in the TSA. In the Kamloops Forest Region, which contains the Merritt TSA, the previous timber supply review (1994/95) led to a decrease in the conventional AAC of 0.7%, or about 50 000 cubic metres.

Mill-level impacts will not occur solely due to changes in the volume of timber harvested from the Merritt TSA; they also result from harvest changes that occur across the region. It is impossible to predict, however, which mills and regions will be most affected, or if new "value-added" operations will offset or exacerbate some of these changes.

7.4 Summary

The forestry sector is an important source of employment and income for the Merritt TSA. About 24% of the total employment in the Merritt area is based on the forestry sector.

Over the last four years 95% of the TSA's processing facilities' requirements of about 1.49 million cubic metres per year came from Merritt TSA sources.

Since January 1999, the AAC for the Merritt TSA has been temporarily increased to 2 004 250 cubic metres per year. This increase was an emergency measure to address the catastrophic impact of the large mountain pine beetle infestation and the 1998 Lawless Creek Fire. Although the socio-economic analysis examined this harvest level, it was not used as a benchmark for assessing impacts from the base case harvest level, due to its temporary status.

Based on the total volume billed during 1996-1999, the average harvest level was 1 424 218 cubic metres per year. This harvest level supported about 1,274 person-years of direct employment and about 1,733 person-years of indirect and induced employment across the province.

The base case harvest forecast for the Merritt TSA indicates that the timber supply could be maintained at 1 445 550 cubic metres for the next six decades. If fully harvested and utilized, the base case harvest level could support about 1,293 person-years of direct employment and about 1,759 person-years of indirect and induced employment across the province. It is projected to generate about $51.3 million per year in provincial government revenues.

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9 Glossary

Allowable annual cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.
Analysis unit	A grouping of types of forest - for example, by species, site productivity, silvicultural treatment, age, and or location, done to simplify analysis and generation of timber yield tables.
Base case forecast	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Biodiversity (biological diversity)	The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic (BEC) variant	A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Clearcut harvesting	A harvesting method whereby all trees that meet utilization standards are harvested. The harvested site is then regenerated to acceptable standards by appropriate means including planting and natural seeding.
Coniferous	Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.
Culmination age	The age at which a timber stand reaches its highest average growth rate, or mean annual increment (MAI). MAI is calculated as stand volume divided by stand age. Culmination age is the optimal biological rotation age to maximize volume production from a growing site.
Cultural heritage resource	An object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community or an aboriginal people.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

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Deciduous	Deciduous trees commonly have broad-leaves and usually shed their leaves annually.
Employment coefficient	The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.
Employment multiplier	An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.
Environmentally sensitive areas	Areas with significant non-timber values, fragile or unstable soils, or impediments to establishing a new tree crop, or areas where timber harvesting may cause avalanches.
Forest cover objectives	Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see **Cutblock adjacency guidelines and Green-up**).
Forest cover requirements	Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see **Cutblock adjacency guidelines and Green-up**).
Forest inventory	An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.
Forest Practices Code	Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Free-growing	An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.

Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
Harvest forecast	The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Indirect and induced jobs	Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.
Inoperable areas	Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.
Integrated resource management (IRM)	The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.
Landscape-level biodiversity	The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.
Landscape unit	A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Long-term harvest level	A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

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Mean annual increment (MAI)	Stand volume divided by stand age. The age at which average stand growth, or MAI, assumes its maximum is called the culmination age. Harvesting all stands at this age results in a maximum average harvest over the long term.
Not satisfactorily restocked (NSR) areas	An area not covered by a sufficient number of well spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.
Old seral	Old seral refers to forests with appropriate old forest characteristics which provide for biodiversity. Ages vary depending on forest type and biogeoclimatic variant.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partition	A portion of the AAC that is attributable to certain types of timber and/or terrain.
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
Protected area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Scenic area	Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Selection management	A silvicultural system used to maintain or create areas containing a wide range of tree ages or sizes. The time interval between harvests in such areas is fairly short (usually less than 30 years), and during these harvests either single scattered trees or small groups of trees are removed from across the entire area.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.

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Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Stand-level biodiversity	A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Timber harvesting land base	Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)	An integrated resource management unit established in accordance with *Section 7* of the *Forest Act*.
Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Ungulate	A hoofed herbivore, such as deer.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.
Visual quality objective (VQO)	Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Woodlot licence	An agreement entered into under the *Forest Act*. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Merritt TSA Timber Supply analysis. This information represents current forest management in the area.

Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced, are not included in this appendix.

The purpose of the Timber Supply Review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

More detail on the derivation of many of the land base exclusions and modelling approaches is available in the September 1999 *Merritt Timber Supply Area Timber Supply Review Data Package*.

A.1 Inventory Information

Table A-1. Inventory information

Data	Mapsheets / letter block	Year of re-inventory	Updated to	Projection date
Forest cover Operability Biogeoclimatic classifications Ownership Public sustained yield unit Roads District / TSA boundaries	**82L**: 001, 011, 021, 031	1970	1994	1998/99
	82E 041, 051	1969	1994	1998/99
	92H: 007, 008, 017, 018, 019, 020, 026, 027, 028, 029, 030, 036, 037, 038, 039, 040, 046, 047, 048, 049, 050, 056, 057, 058, 059, 060, 065, 066, 067, 068, 069, 070, 075, 076, 077, 078, 079, 085, 086, 087, 088, 089, 095, 096, 097, 098, 099	1991	1998/99	1998/99
	92H: 035, 045, 055, 074, 084, 094	1970	1998/99	1998/99
	92I: 004, 005, 006, 007, 008, 009, 010, 015, 016, 017, 018, 019, 020, 025, 026, 027, 028, 029, 030, 035, 036, 037	1991	1998/99	1998/99
	92I: 014, 024, 034, 038, 039, 040, 044, 045, 046,047	1991	1998/99	1998/99
	92I: 048	1996	1995	1998/99

A.1 Inventory Information

Table A-2. Non-corporate inventory information

Data	Source	Date created	Update	Scale
Stream riparian buffers for classified streams	Ministry of Forests (MoF) Merritt	1999		1:20 000
Biogeoclimatic ecosystem classifications (BEC)	Research Branch	1990	1994	1:20 000
Community watersheds	Ministry of Environment, Lands and Parks (MELP), Water Management Branch		1999	1:20 000
Visual quality objectives (VQOs)	MoF Merritt	1995	1998	1:20 000
Operability lines	MoF Merritt	1997-98	1998	1:20 000
Terrain stability	MoF Merritt	1996-1998		1:20 000
Parks and ecological reserves	MoF / MELP	1995/1996/ 1998		1:20 000
Proposed protected areas (areas of interest and approved study areas)	MoF/MELP	1995	1998	1:20 000
Stoyoma Mountain area	MoF Merritt	1994		1:20 000
Ungulate winter range	MoF/MELP	1994		1:50 000
Landscape unit boundaries and draft biodiversity emphases	MOF/MELP	1996	1998	1:20 000
Hudson Bay designated heritage trail	MoF	1994		1:20 000
New woodlots	MoF	1999		1:20 000
Elk movement corridors	MELP	1998		1:20 000
Archaeological sites	Small Business, Tourism and Culture	1996		1:20 000
Lawless Creek wildfire # 639	MoF	1998	1998	1:20 000
Steep slope > 65% mapping	MoF	1999		1:20 000

Data source and comments:

The following information is not contained within the current MoF inventory:

- proposed protected areas, landscape units, ungulate winter range areas, elk corridors, community watersheds and intakes, Stoyoma Mountain area, terrain stability mapping, steep slope mapping, visually sensitive areas, woodlots, stream, lake and wetland buffers.

This information has been merged with the standard inventory file to produce the inventory file to be used in this analysis. All of this information resides in the Merritt Forest District.

A.2 Zone and Analysis Unit Definition

A.2.1 Management zones, groupings and objectives

Management zones represent areas with distinct management emphasis. For example, a zone may be based on a harvesting system, silviculture system, visual quality objective or wildlife consideration. Some areas may be subject to more than one management objective. For simulation modelling, a "group" function enables application of overlapping constraints.

Table A-3. provides general descriptions of the management objectives and related information to be tracked in the analysis. The non-contributing forest (i.e., land considered unavailable for timber harvesting) is included for consideration in attaining forest cover objectives for landscape-level biodiversity, community watersheds, ungulate winter range, and elk movement corridors. For visual quality objectives, some non-productive forest areas (in addition to the non-contributing forest) contribute to forest cover objectives.

Further information on the forest cover requirements to be applied to these areas can be found in Section A.4.9, "Forest cover requirements."

A.2 Zone and Analysis Unit Definition

Table A-3. Management objective zones and groupings

Zone/group	Management issue
Landscape units	There are 14 draft landscape units, 12 of which are partitioned by two or more draft biodiversity emphasis options. This grouping is used for reporting of total forest by landscape unit (LU).
Biogeoclimatic variants	Each biogeoclimatic subzone/variant has its own numeric identifier. Landscape-level biodiversity requirements are applied at the LU/BEC subzone/variant level. All Crown forest area including parks is considered for the requirement.
Grasslands	All areas identified as 'Grassland' biodiversity emphasis within the timber harvesting land base are harvested only once in the planning horizon, then transferred to the non-contributing forest land base to reflect conversion of these forested sites to grasslands.
Community watersheds	Each of the 10 community watersheds are subject to maximum disturbance limits that are applied to the Crown forest area within each community watershed.
Visual quality objectives (VQOs)	Each VQO polygon larger than 10 hectares is treated as an discrete unit for application of green-up requirements for visual quality. These requirements are applied according to provincial guidelines (*Procedures for Factoring Visual Resources in Timber Supply Analyses*). The Crown forest area and certain non-productive forest stands are included in assessment of forest cover.
Elk movement corridors	Both green-up forest cover requirements and mature forest cover requirements are applied to the Crown forested area within the area of elk movement corridors.
Ungulate winter range	Areas managed for ungulate winter range. Both green-up forest cover requirements and mature forest cover requirements are applied to the Crown forest area within each ungulate winter range / landscape unit area.
Standard management	The standard integrated resource management zone covers all areas not within VQO polygons, elk corridors, ungulate winter range, and community watersheds. A 3-metre green-up requirement is applied to approximate *Forest Practices Code* (FPC) cutblock adjacency requirements. This requirement is applied individually to each LU / Standard management zone area.
Smallwood stands	All stands in smallwood analysis units are identified for reporting purposes, and to model the partition established for these stands.
Selection management	All timber harvesting land base areas managed under a selection harvesting regime are identified and tracked through the analysis, both for reporting purposes and for modelling the regime used.

A.2 Zone and Analysis Unit Definition

Data source and comments:

See Section A.1, "Inventory information" for the sources of the management zone information referenced above.

Details on the assumptions used to model grasslands is described in Section A.3.14, "Future land base reductions for conversion of grasslands." The assumptions used for smallwood stands and selection management are discussed below in Section A.2.2, "Analysis units."

A.2.2 Analysis units

An analysis unit represents forest stands with similar tree species (as indicated by the inventory type group), similar timber growing capability (as indicated by the site index in the forest inventory file) and similar management regimes. Each analysis unit was assigned its own timber volume projections (growth curves) for existing and future stands.

Yield tables for existing natural stands was derived using the variable density yield prediction (VDYP) yield model. Yield tables for recent plantations and future stands were derived using the table interpolation program for stand yields (TIPSY).

Table A-4. Definition of analysis units

Analysis unit (leading species)	Inventory type groups	Biogeoclimatic subzone	Site index range (m @ 50 years)	Age (years)
Conventional harvest land base				
(1) Fir / Yellow pine / Dry – selection	1, 6, 7, 8, 32 – 34	BG, PPxh, IDFxh, IDFdk1	All	All
(2) Fir / Yellow pine / Dry – selection	1, 6, 7 – 8, 32 – 34	IDFdk2, MSxk, except for FS, FH, FC, FB or FPL type groups	All	All
(3) Fir / Wet – young	1, 2 – 4, 6 – 8	All except those specified in analysis units 1 and 2	15.1+	< 141
(4) Fir / Wet – old	1, 2 – 4, 6 – 8	All except those specified in analysis units 1 and 2	15.1+	≥ 141
(5) Fir / Wet – young	1, 2 – 4, 6 – 8	All except those specified in analysis units 1 and 2	0-15.0	<141
(6) Fir / Wet – old	1, 2 – 4, 6 – 8	All except those specified in analysis units 1 and 2	0-15.0	≥ 141
(7) Pine / Fir – young	5, 29	All	15.1+	< 141
(8) Pine / Fir – old	5, 29	All	15.1+	≥ 141
(9) Pine / Fir – young	5, 29	All	0 – 15.0	< 141
(10) Pine / Fir – old	5, 29	All	0 – 15.0	≥ 141
(11) Pine / Spruce – young	25, 30, 31	All	15.1+	< 141
(12) Pine / Spruce – old	25, 30, 31	All	15.1+	≥ 141

(continued)

Table A-4. Definition of analysis units (concluded)

Analysis unit (leading species)	Inventory type groups	Biogeoclimatic subzone	Site index range (m @ 50 years)	Age (years)
(13) Pine / Spruce – young	25, 30, 31	All	0 – 15.0	< 141
(14) Pine / Spruce – old	25, 30, 31	All	0 – 15.0	≥ 141
Conventional harvest land base				
(15) Pine – young	28	All	15.1+	< 141
(16) Pine – old	28	All	15.1+	≥ 141
(17) Pine – young	28	All	0–15.0	< 141
(18) Pine – old	28	All	0–15.0	≥ 141
(19) Balsam / Hemlock – young	12 – 20	All	13.1+	< 141
(20) Balsam / Hemlock – old	12 – 20	All	13.1+	≥ 141
(21) Balsam / Hemlock – young	12 – 20	All	0–13.0	< 141
(22) Balsam / Hemlock – old	12 – 20	All	0–13.0	≥ 141
(23) Spruce / Western White Pine / Cedar – young	9 – 11, 21 – 24, 26, 27	All	14.1+	< 141
(24) Spruce / Western White Pine / Cedar – old	9 – 11, 21 – 24, 26, 27	All	14.1+	≥ 141
(25) Spruce / Western White Pine / Cedar – young	9 – 11, 21 – 24, 26, 27	All	0–14.0	< 141
(26) Spruce / Western White Pine / Cedar – old	9 – 11, 21 – 24, 26, 27	All	0–14.0	≥ 141
Smallwood pine partition				
(27) Pine – young	28 – 31	All	See smallwood definition in Table A-5 below	< 141
(28) Pine – old	28 – 31	All	See smallwood definition in Table A-5 below	≥ 141

A.2 Zone and Analysis Unit Definition

Table A-5. Criteria used to define the smallwood partition.

Inventory type groups	New site index (m @ 50 years)	Age class	Projected height class
28–31	≥ 8 < 10	1–3	< 3
28–31	≥ 8 ≤ 14	4–9	< 3

Table A-6. Inventory type group definitions

Inventory type group (ITG)	Name	First species	Second species	Examples
1	Fd	Fd >80%	Any	Fd, FdPw, FdPwC1w
2	FdCw	Fd	Cw or Yc	FdCw, FdYc, FdCwH
3	FdH	Fd	H or B	FdH, FdB, FdHCw
4	FdS	Fd	S	FdS, FdSB, FdSH
5	FdPl	Fd	Pl	FdPl, FdPlH, FdPlPy
6	FdPy	Fd	Py	FdPy, FdPyL, FdPyPl
7	FdL	Fd	L, Pw	FdL, FdLPy, FdPwS
8	FdDecid	Fd	Decid	FdDr, FdMb, FdAc
9	Cw	Cw/Yc > 80%	Any	Cw, Yc, CwYc, CwPl
10	CwFd	Cw/Yc	Fd, L, Py, Pw, Pl, or dec.	CwFd, CwL, YcFd
11	CwH	Cw/Yc	H, B, or S	CwH, CwB, CwS, YcH
12	H	H > 80%	Any	H, HPw, HPl, HPlYc
13	HFd	H	Fd, L, Py, Pw or Pl	HFd, HL, HFdCw
14	HCw	H	Cw or Yc	HCw, HYc, HCwYc
15	HB	H	B	HB, HBS, HBCw
16	HS	H	S	HS, HSB, HSAc
17	HDecid	H	Decid	HAc, HDr, HAcB
18	B	B > 80%	Any	B, BFd, BPw, BPl
19	BH	B	H, Cw, or Yc	BH, BCw, BYc, BHCw
20	BS	B	S, Fd, Pw, Pl, L, Py, or dec.	BS, BSPl, BSAt
21	S	S > 80%	Any	S, SYc, SPw
22	SFd	S	Fd, L, Pw or Py	SFd, SL, SPy, SFdB
23	SH	S	H, Cw or Yc	SH, SCw, SHAc
24	SB	S	B	SB, SBAc, SBH
25	SPl	S	Pl	SPl, SPlB, SPlFd

(continued)

A.2 Zone and Analysis Unit Definition

Table A-6. Inventory type group definitions (concluded)

Inventory type group (ITG)	Name	First species	Second species	Examples
26	SDecid	S	Decid	SAt, SAc, SAcB
27	Pw	Pw	Any	Pw, PwFd, PwCwH
28	Pl	Pl/Pa > 80%	Any	Pl, Pa, PlPa, PaPl
29	PlFd	Pl	Fd, Pw, L, or Py	PlFd, PlPy, PlL, PlFdH
30	PlS	Pl	S, B, H, Cw, or Yc	PlS, PlB, PlH, PlBS
31	PlDecid	Pl	Decid	PlAt
32	Py	Py	Any	Py, PyFd, PyL, PyPl
33	LFd	L < = 80%	Fd	LFd, LFdPy
34	L	L	Any(Fd when L > 80%)	L, LPy, LPl, LPyFd
35	AcConif	Ac	Conif	AcS, AcH
36	AcDecid	Ac	Decid	DrFd, DrCwH
38	DrDecid	Dr	Decid	Dr, DrMb
39	Mb	Mb	Any	Mb, MbDr, MbFd
40	E	E	Any	E, EAt, ES
41	AtConif	At	Conif	AtPl, AtS, AtFd
42	AtDecid	At	Decid	At, AtAc, AtE

Data source and comments:

Growth of stands less than or equal to 25 years as of late 1998 / early 1999 have been projected with managed stand yield tables (MSYT) generated using TIPSY. Managed stands are identified in the analysis according to the above table, except with a '100' prefix (for example, 101, 102, 103, 105, and so on). Existing non-selection stands that are differentiated only by age group (but not by site index or inventory type group) are assumed to regenerate to the same managed stand yield curve. For example, analysis units 3 and 4 are identical except that analysis unit 3 is composed of good site fir stands younger than 141 years; while analysis unit 4 is composed of good site fir stands 141 years and older. Both stands regenerate to analysis unit 103. Similarly, analysis units 5 and 6 regenerate to analysis unit 105.

Selection stands are modelled using the following assumptions: harvesting occurs at or after stands meet their minimum harvestable age (described below in Section A.4.2, "Minimum harvestable age derivation"). At time of harvest, 25% of the stand volume is removed. The stand cannot be re-entered for at least another 30 years. At each harvest throughout the planning horizon, 25% of the stand volume is removed (after operational adjustment factors (OAF) are applied).

A harvest target of 250 000 cubic metres per year is applied to smallwood pine stands for the first 70 years of the planning horizon to model harvesting of the 250 000 cubic metres per year partition. Over time, the smallwood pine stands are converted to regenerated stands with lower densities and better height growth, as described in Section A.4.5, "Silviculture and regeneration activities." After 70 years of the planning horizon, harvest of these areas is tracked, but not limited to 250 000 cubic metres per year.

A.3 Definition of the Timber Harvesting Land Base

A.3.1 Land not owned and administered by the province of British Columbia; private forest lands; tree farm licences; leases

The total land base is stratified into various ownership codes. Land must be British Columbia Crown land under provincial administration for it to contribute to the land base used to determine timber supply. However, even some areas under provincial administration, such as tree farm licences, do not contribute to timber supply in this analysis. The following ownership types within the district were not considered to contribute to the timber harvesting land base or other forest management objectives in the TSA, and were excluded from the land base modelled in the analysis:

Table A-7. Ownership categories that do not contribute to the timber harvesting land base or other forest management objectives in the Merritt TSA

Ownership code	Definition
IN	Unknown ownership[a]
40N	Private Crown grant
50N	Federal reserve
52N	Indian reserve
75N	Christmas tree
76N	Tree farm licences
99N	Small leases

(a) Total area without ownership description is less than 15 hectares.

A.3.2 Woodlot licences

Woodlot licences are managed for timber production. However, they are administered separately from the TSA. While the Minister of Forests initially apportions a part of the TSA AAC to woodlots, once an AAC is allocated to a specific woodlot licence, the area and the associated AAC are no longer administered as part of the TSA. Consequently, allocated woodlots do not contribute to the TSA timber harvesting land base.

Ordinarily, ownership code '77N' is used to identify these areas. However, the Merritt Forest District provided new woodlot mapping for use in the timber supply analysis (see Table A-2., "Non-corporate inventory information"), and this information was used instead of the outdated forest cover ownership mapping. Using the new woodlot mapping, 17 321 hectares of woodlot licences have been identified as woodlot licences in the district. These areas are excluded from the timber harvesting land base.

The AAC attributable to these areas is not included in the assessment of the current AAC for the Merritt TSA. At the time the Merritt timber supply analysis was undertaken, the total volume allocated to woodlot licences was 20 200 cubic metres per year. A total of 11 500 cubic metres per year in allocated woodlot volume was accounted for in TSR 1 for the Merritt TSA, and the 'current AAC' harvest level reflected this volume. Accordingly, the difference in volume (8700 cubic metres per year) has been attributed to additional woodlot licences in this analysis. This woodlot licence volume has been deducted from the total AAC of the Merritt TSA (along with deductions for non-recoverable losses, described below in Section 4.4, "Unsalvaged losses"), resulting in the current AAC volume used in the analysis.

A.3.3 Land classified as non-forest or non-productive forest

Alpine, lakes, rock, etc., represented by inventory type identities 6 and 8, were excluded from the timber harvesting land base. Certain types of non-productive forest (those stands with a projected height class greater than or equal to 2 and a crown closure class of greater than or equal to 3) are considered to have suitable attributes to be considered in the assessment of forest cover requirements for visually sensitive areas. These stands account for 8717 hectares of the area excluded from the timber harvesting land base.

A.3.4 Non-commercial cover

Inventory type identity 5 represents areas currently occupied by non-commercial brush species. These areas are considered unlikely sites for timber production and were excluded from the area available for timber harvesting.

A.3.5 Land not administered by the British Columbia Forest Service for timber supply

Land under provincial Crown administration may contribute to forest management objectives even if it is not available for timber harvesting. For example, provincial park land provides old-growth to help achieve biodiversity objectives. Areas with the following ownership codes do not contribute to timber supply in the analysis, but are considered in the assessment of forest cover requirements.

Table A-8. Ownership categories that are excluded from the timber harvesting land base but contribute to some forest management objectives.

Ownership code	Definition
60N	Crown / ecological reserves
63N	Class A parks
67N	Provincial parks, park equivalents, or reserves

Of the provincial Crown ownership codes occurring within the Merritt Forest District, only the following are considered to contribute to timber supply for harvest forecast and AAC determination purposes:

Table A-9. Ownership categories that are included in the timber harvesting land base.

Ownership code	Definition
61C	Large reserves for the use, recreation and enjoyment of public (UREPs)
61N	Small UREPs (less than 100 hectares)
62C	Crown forest management unit
69C	Large Crown reserves
69N	Small Crown reserves (less than 100 hectares)
77N	Woodlot licences[a]

(a) Woodlots are removed from the timber harvesting land base on the basis of 'licensee' description. See Section A.3.2, "Woodlot licences," above.

A.3.6 Environmentally sensitive areas

Some lands are environmentally sensitive and/or significantly valuable for other resources. These areas are identified during a forest inventory as environmentally sensitive areas (ESAs). Table A-10. lists the types of ESAs where no harvesting is expected to take place, and which have been excluded from the timber harvesting land base.

Table A-10. Description of environmentally sensitive areas

ESA class	ESA description	Per cent (%) area reduction
ESA_1 = 'A'	Stands having severe snow chute or avalanche problems.	100
ESA_1 = 'H'	Areas requiring protection to maintain water quality, quantity and seasonal distribution.	100
ESA_1 = 'P'	Areas where severe plantation problems are expected.	100
ESA_1 = 'R'	Areas having significant value for recreational activity or viewing enjoyment.	100
ESA_1 = 'S'	Areas with fragile or unstable soils.	100
ESA_1 = 'W'	Areas with significant value for food, shelter, or reproduction for wildlife	100

Data source and comments:

For the purposes of this document, environmentally sensitive area reductions were established by the Ministry of Forests (MoF) staff in collaboration with the Ministry of Environment, Lands and Parks (MELP). The percentages reflect site sensitivity to forest management, value for other resources, and current management practices.

It is expected that certain ESAs may be replaced by alternative classifications and mapping over the next few years. Until such time that this information is collected, any existing mapping and classification data (e.g., terrain — see discussion of inoperable areas — and wildlife habitat) is used in addition to ESA1 classifications.

All moderately sensitive areas (ESA2) have been fully included in the timber harvesting land base. During site-specific operational planning, small portions of some ESA2s are likely to be excluded from timber harvesting. It is also likely that minor portions of some ESA1s may be available for harvesting, which offsets the inclusion of all ESA2s. On balance, the approach outlined in Table A-10. reflects practices in the Merritt TSA.

A.3.7 Inoperable areas

Operability codes are used to classify areas based on physical or economic considerations that affect the ability to harvest stands. Characteristics used in defining operability include slope, topography (e.g., gullies or exposed rock), difficulty of road access, soil instability, elevation and timber quality. Operability can change over time with new harvesting technologies and changing economics. All areas described as inoperable from the operability line work are excluded from timber harvesting in this analysis.

In addition to operable/inoperable codes, more detailed terrain stability mapping has been conducted in certain areas of the Merritt TSA. This mapping includes a degree of field verification and classifies areas as to their degree of potential instability. Areas identified as terrain class V have been excluded from the timber harvesting land base.

Slopes greater than 65% for areas (polygons) one hectare and greater in size are excluded from timber harvesting, except where terrain stability mapping has been completed. In this case, terrain stability mapping has taken precedence over slope information.

Table A-11. Description of inoperable areas

Inventory description	Reduction per cent (%)
Inoperable	100
Slopes greater than > 65%	100
Terrain class V	100

Data source and comments:

Operability lines for the Merritt TSA were originally delineated by the Ministry of Forests based on 1991 photos and were completed in 1998.

Terrain classification mapping has been completed for the Hedley/McNulty, Spius River, and Tulameen areas. Terrain class V is considered completely inoperable.

A.3.8 Problem forest types

Problem forest types occupy sites that have the potential to produce merchantable timber, but currently are not utilized due to marginal economics (low volumes and/or quality). As these stands are not considered to be harvestable, they are excluded from the timber harvesting land base.

Table A-12. Problem forest types criteria

Species	Inventory type group	New site index (m at 50 years)	Projected age class	Projected height class	Projected height (metres)	Crown closure class	Silviculture opening number assigned[a]	Per cent (%) excluded
All coniferous	1–27, 32–34	< 10.5	1–3				No	100
Deciduous	35–42							100
Fir / Yellow pine / Larch leading	1–8, 32–34	< 10.0	4–9	< 3			No	100
Pine leading	28–31	< 8.0	1–3				No	100
Pine leading	28–31	< 8.0	4–9	< 3			No	100
Balsam / Spruce / Hemlock / Cedar	9–27	< 14.0	4–9		< 22.0	<3 or >7	No	100

(a) Stands that have been assigned silviculture opening numbers have been subjected to management actions in the past (such as harvesting) and are generally considered to be under "active management." These areas are considered to be available for future harvesting.

A.3 Definition of the Timber Harvesting Land Base

A.3.9 Cultural heritage resources

Cultural heritage values include archaeological sites and traditional uses of the land. An archaeological overview assessment has not been completed for the Merritt TSA. However, in 1998, an archeological site inventory project was assembled from existing inventory information from the Ministry of Small Business, Tourism and Culture's Heritage Conservation Branch. To account for forest management practices used near these sites, a 50-metre radius no-harvest buffer has been applied around each site. This buffer area is excluded from the timber harvesting land base.

A.3.10 Riparian areas

Specific areas are excluded from the timber harvesting land base to account for riparian reserve and management zones, as outlined in Tables A-13a. and A-13b.

A.3 Definition of the Timber Harvesting Land Base

Table A-13a. Estimates for riparian reserve and management zones for streams, wetlands and lakes

Riparian classification	Riparian reserve zone (RRZ) width (metres each side)	Riparian management zone (RMZ) width (metres each side)	RMZ basal area retention (%)	Riparian buffer width (metres each side)
Streams				
Stream buffer applied to all TRIM 1 streams				10
Wetlands				
W1	10	40	25	20
W2	10	20	25	15
W3	0	30	25	7.5
W4	0	30	25	7.5
W5	10	40	25	20
Lakes				
L1 lakes (> 5 hectares)	10	0	0	10
L2 lakes (1–5 hectares in BG, PP, IDFxh BEC zones)	10	20	25	15
L3 lakes (1–5 hectares not in above L2 BEC zones)	0	30	25	8
L4 lakes (0.25–1 hectare in BG, PP, IDFxh BEC zones)	0	30	25	8
Lakes > 3 hectares classified through Merritt TSA lakes classification process	(see Table A-13b.)			

Table A-13b. Estimates for riparian reserve and management zones for lakes classified through the Merritt TSA lakes classification process

Lake class	Lakeshore management zone (metres)	Basal area retention %	Modelled riparian buffer width (100% removed)
A	200	100	200
B	200	50	100
C	200	25	50
D	200	10	20
E	200	5	10

Data source and comments:

Retention levels for streams, wetlands and lakes reflect a combination of best management practices, current management and recommended basal area retention as described in the *Riparian Management Area Guidebook*. Modelled riparian buffer widths account for both reserve zones (where one exists), and management zones.

A 10-metre riparian buffer has been applied to all existing streams within the Terrain Resource Information Mapping system (TRIM) base. The 10-metre riparian buffer width was determined based on estimates of riparian management area retention levels made by Merritt Forest District staff, and a geographic information system (GIS)-estimated average riparian zone width using existing stream classification data across several watersheds (approximately 7% of the TSA).

Consistent with the Merritt TSA Lakes Classification Process, all lakes classified through this process have a lakeshore management zone (LMZ) that extends beyond the riparian reserve zone (where one exists) by a distance of approximately 200 metres. For modelling purposes, the LMZ is assumed to include the RRZ, where one exists. Harvesting is not permitted within the LMZ of Class A lakes, and basal area retention amounts are prescribed for class B, C, D and E lakes.

A.3.11 Exclusion of specific, geographically defined areas

Areas recognized by legislation or Order-in-Council as not contributing to the timber harvesting land base — for example, established parks — are excluded from the timber harvesting land base. However, areas that have been deferred from harvesting because they are contentious or are under study (e.g., planning deferrals, potential parks) are normally not excluded from the timber harvesting land base to avoid speculating on the outcome of government decisions. As a result, in this analysis, these deferred areas are considered available for timber harvesting. Any changes in official designation will be incorporated in future timber supply reviews.

Specific areas that are unavailable for harvesting, but that have not been identified elsewhere are listed in Table A-14.

A.3 Definition of the Timber Harvesting Land Base

Table A-14. Exclusion of specific, geographically defined areas

Description	Excluded total land base area	Reason for exclusion
Hudson's Bay Trail (designated portion)	100 metres each side of trail	As described in draft *Hudson Bay Trail Management Plan*
Water intakes for community watersheds	1.57 hectare/intake	*Forest Practices Code* regulatory requirement specifies 100-metre no harvest buffer upslope of community watershed intakes

A.3.12 Roads, trails and landings

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings. The reductions to account for existing roads, trails and landings (described below in Table A-15.) are applied to the productive forest land base currently considered available for harvesting. Reductions for future roads, trails and landings apply to future stands on areas currently not harvested, and are applied only once after stands are harvested for the first time in the simulation model to reflect areas that will be occupied by future roads, trails and landings once harvest is complete. In the analysis, a percentage of the area is removed from each forest stand within specified age classes and zones to account for these future productive forest losses (see Table A-15.). Estim[illegible] account only for the area that will be permanently removed from the timber harvesting land base.

Table A-15. Estimates for existing and future roads, trails and landings

Description	Loss on timber harvesting land base due to roads, trails and landings (%)
Existing roads in polygons > 40 years of age	0.4
Existing landings and on-block disturbance for areas < 40 years of age	9.3
Future roads, landings and on-block disturbance	6.9

Data source and comments:

The above estimates were determined by the Regional Research Pedologist through measurements performed on eight watersheds within the Merritt Forest District, and studies performed elsewhere in the Kamloops Forest Region.

A.3.13 Wildlife tree patches

Stand-level biodiversity is provided for in the Merritt TSA in several different ways:

- wildlife trees left inside cutblocks (single tree reserves);
- wildlife tree patches inside cutblocks (group reserves); and
- wildlife tree patches adjacent to or external to cutblocks, and outside the timber harvesting land base (approximately 50% of all wildlife tree retention).

None of these wildlife trees or wildlife tree patches are expected to be harvested in the future. Therefore, they do not contribute to timber supply in this analysis. Single tree reserves are modelled in this analysis by reducing yield curves, as discussed below under Section A.4.8.1, "Wildlife trees." Wildlife tree patch retention is modelled in this analysis by reducing the size of the timber harvesting land base. The following reasoning was used to derive both the percentage yield reduction applied to stand volumes to account for the retention of single trees and the reduction percentages applied to the timber harvesting land base to account for the retention of wildlife tree patches.

Table A-16. Reduction in size of the timber harvesting land base to reflect retention of wildlife tree patches

1.	Average % of gross cutblock area in wildlife trees	10.7
2.	Reduction in % retention expected with establishment of LU objectives	–3
3.	Expected % of gross cutblock area following establishment of LU objectives	7.7
4.	Amount of wildlife tree retention met by areas outside the timber harvesting land base	50%
5.	Per cent of the timber harvesting land base affected by wildlife trees	3.85
6.	% reduction in timber harvesting land base to account for wildlife tree patches	1.93
7.	% reduction in stand volume to account for single tree retention[a]	1.93[a]

(a) Discussed in Section A.4.8, "Reductions to reflect volume retention in cutblocks."

Data source and comments:

Since wildlife tree patches greater than two hectares in size can contribute to landscape-level biodiversity requirements, these areas were excluded from the timber harvesting land base but maintained as part of the productive forest land base for the assessment of forest cover requirements.

Estimates of volumes retained in single tree reserves and wildlife tree patches were derived for the Merritt TSA through information gathered from silviculture prescriptions for the period July 1997 to December 1998. On average, SPs noted a retention of 10.7% of the gross cutblock area in WTPs. It is further assumed that landscape-level objectives established for old forest and WTP targets will be modelled based on Table 20a of the *Biodiversity Guidebook*. It was estimated that the initial target area could then be reduced by 3 percentage points (i.e., by comparing WTP retention levels from Table 20b to Table 20a in the *Biodiversity Guidebook)*. It was further assumed that 50% of WTPs are in areas outside of the timber harvesting land base, such as inoperable forest, and volume not currently included in the volume estimates (e.g., veterans). Of the wildlife trees within the timber harvesting land base, half were expected to be patches larger than 2 hectares that will also serve as WTPs for future nearby cutblocks, as well as contribute to landscape-level biodiversity objectives. The remaining amount of retained wildlife trees within cutblocks was assumed to be single trees, and were addressed through a reduction in the yield curves, as discussed in Section A.4.8.1, "Wildlife trees." District staff attempted to account for tree type and quality in estimating wildlife tree retention levels.

A.3.14 Future land base reductions for conversion of grasslands

Portions of the Merritt TSA include grasslands ecosystems that are being encroached upon by Douglas-fir forests. The Merritt Forest District intends to manage some of these areas by harvesting the timber and then managing them as grasslands rather than as forests. To model this management regime, all areas identified with a 'Grasslands' biodiversity emphasis (listed below in Table A-24. "Draft landscape units and draft biodiversity emphases") were allowed to be harvested once in the analysis. After this point, the areas were removed from all consideration in the analysis in the same manner as future roads, trails, and landings.

A.4 Forest Management Assumptions

A.4.1 Utilization levels

Timber utilization levels define the maximum stump height, minimum top diameter inside bark (dib) and minimum diameter at breast height (dbh) by species and are used in the analysis to calculate merchantable volume. Table A-17. shows the standards and license requirements currently in place for wood utilization in the Merritt TSA.

Table A-17. Utilization levels

	Utilization		
Analysis unit / species	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**
Lodgepole pine	12.5	30	10
All other coniferous species	17.5	30	10

Data source and comments:

Table A-17. reflects current regional standards, license requirements and current performance, with one notable exception: smallwood pine stands are utilized to 7.5 cm minimum dbh, a 20 cm maximum stump height, and a 7 cm minimum top dib. These stands were assumed to have the same utilization as all other lodgepole pine stands because at the time of the analysis, data was not available on the amount of additional volume this utilization level would yield.

A.4.2 Minimum harvestable age derivation

Minimum harvestable ages provide an estimate of the minimum age a stand must reach before it can be harvested. They define the lower limit for harvesting. Harvesting may occur in stands at the minimum requirements (for example, to maintain harvest levels for a short period of time or avoid large disruptions in harvest levels). However, most stands will not be harvested until well past the minimum timber production ages because management objectives for other resource values take precedence (e.g., requirements for the retention of older forest).

Tables A-18. and A-19. provide statistics related to the definition of minimum harvestable ages for existing and regenerated stands. The criteria that was ultimately used for the minimum harvestable age is printed in bold, along with the minimum harvestable age.

A.4 Forest Management Assumptions

Table A-18. Minimum harvestable ages criteria for existing unmanaged stands

AU	Description	Default minimum	Minimum volume (m^3/ha)		Culmination age (max MAI years)	90% of maximum MAI age (years)	Re-entry period	Minimum harvestable age
			Vol	Age				
1	Fir / Yellow pine (dry)	**120**	125	120	150	110	30	**120**
2	Fir / Yellow pine (dry)	**120**	125	113	140	100	30	**120**
3	Fir wet young, good / medium site (GM)	**100**	150	78	120	90	N/A	**100**
4	Fir wet old GM	**100**	150	81	120	90	N/A	**100**
5	Fir wet young, poor site (P)	N/A	150	**134**	140	110	N/A	**134**
6	Fir wet old P	N/A	150	**123**	140	110	N/A	**123**
7	Pine / Fir young GM	**80**	150	76	110	80	N/A	**80**
8	Pine / Fir old GM	**80**	150	79	110	80	N/A	**80**
9	Pine / Fir young P	N/A	150	**119**	130	100	N/A	**119**
10	Pine / Fir old P	N/A	150	**122**	130	100	N/A	**122**
11	Pine / Spruce young GM	**80**	150	64	100	70	N/A	**80**
12	Pine / Spruce old GM	**80**	150	61	90	70	N/A	**80**
13	Pine / Spruce young P	**100**	150	86	130	90	N/A	**100**
14	Pine / Spruce old P	**100**	150	96	140	100	N/A	**100**
15	Pine young GM	**80**	150	63	100	70	N/A	**80**
16	Pine old GM	**80**	150	63	100	70	N/A	**80**
17	Pine young P	N/A	150	**83**	130	90	N/A	**83**
18	Pine old P	N/A	150	**88**	130	90	N/A	**88**

(continued)

A.4 Forest Management Assumptions

Table A-18. Minimum harvestable ages criteria for existing unmanaged stands (concluded)

AU	Description	Default minimum	Minimum volume (m^3/ha)		Culmination age (max MAI years)	90% of maximum MAI age (years)	Re-entry period	Minimum harvestable age
			Vol	Age				
19	Balsam / Hemlock young GM	**100**	150	76	130	80	N/A	**100**
20	Balsam / Hemlock old GM	**100**	150	75	110	80	N/A	**100**
21	Balsam / Hemlock young P	**120**	150	116	170	110	N/A	**120**
22	Balsam / Hemlock old P	N/A	150	**128**	170	110	N/A	**128**
23	Spruce / Western white pine / Cedar young GM	**100**	150	71	110	80	N/A	**100**
24	Spruce / Western white pine / Cedar old GM	**100**	150	71	110	80	N/A	**100**
25	Spruce / Western white pine / Cedar young P	**120**	150	102	150	110	N/A	**120**
26	Spruce / Western white pine / Cedar old P	**120**	150	114	170	120	N/A	**120**
27	Smallwood pine young	N/A	150	**105**	130	100	N/A	**105**
28	Smallwood pine old	N/A	150	**125**	140	110	N/A	**125**

A.4 Forest Management Assumptions

Table A-19. Minimum harvestable ages criteria for managed stands

AU	Description	Culmination age (max MAI years)	90% of maximum MAI age (years)	Minimum harvestable age
103	Fir wet GM	80	60	60
105	Fir wet P	100	80	80
107	Pine / Fir GM	80	60	60
109	Pine / Fir P	110	80	80
111	Pine / Spruce GM	90	70	70
113	Pine / Spruce P	120	90	90
115	Pine GM	80	60	60
117	Pine P	100	80	80
119	Balsam / Hemlock GM	110	100	100
121	Balsam / Hemlock P	170	130	130
123	Spruce / Western white pine / Cedar GM	100	80	80
125	Spruce / Western white pine / Cedar P	160	120	120
127	Pine from AUs 27 and 28	110	90	90

Data source and comments:

Various different criteria were used to establish minimum harvestable ages. Minimum volumes criteria were examined for existing unmanaged stands; however, in cases where district staff believed these minimum volume criteria resulted in a minimum harvestable age that was unacceptably low, a default minimum was provided that was used instead. For managed stands, stands were required to reach 90% of the age at which they achieve maximum annual growth.

Selection management stands have an initial minimum harvestable age of 120 years. After the initial harvest, stands can be re-entered every 30 years in perpetuity. Each harvest takes 25% of the total accumulated stand volume at the time of harvest.

A.4.3 Harvest scheduling priorities

For the Merritt TSA base case, the Forest Service Simulator (FSSIM) timber supply model selected stands to harvest based on "relative oldest first" (highest priority given to stands that are furthest above their respective minimum harvestable age).

In addition to prioritizing generally older stands, there is also a high priority to harvest smallwood pine stands in the analysis. This priority has been established to ensure that the full amount of the partition is harvested at the start of the planning horizon when the age of these stands makes them less likely candidates for harvesting under the relative oldest first harvest priority. There is a low harvest priority placed on selection stands since district staff indicate that only a small amount of selection harvesting is expected to occur in the short term.

A.4.4 Unsalvaged losses

Table A-20. provides an estimate of average annual volume of timber on the timber harvesting land base that is damaged or killed and *not* salvaged. These losses are attributable to a number of factors that result in tree mortality including insects, wind damage and wildfire.

Table A-20. Unsalvaged losses

Cause of loss	Annual unsalvaged loss (m^3/year)
Insects	93 841
Wind damage	18 565
Wildfire	31 220
	143 626

Data source and comments:

The agents contributing to the unsalvaged losses are those not considered in inventory growth plots or operational adjustment factors (OAFs). Only losses in the timber harvesting land base were considered. Inoperable areas, private land, parks, and other areas not currently part of the productive forest land base were not included in the calculations.

Calculations used for unsalvaged loss estimates:

1) Unsalvaged insect infestations:
Unsalvaged losses due to Mountain Pine Beetle and Spruce Beetle over the past 9 years were estimated to average 93 841 cubic metres per year. This estimate, which relates to the timber harvesting land base, was determined based on a review of aerial survey information and proposed harvest plans. Other insect losses are presumably accounted for in the current inventory and OAFs.

2) Unsalvaged windthrow (catastrophic events or along cutblocks):
District staff estimated that windthrow in small scattered patches, along cutblock edges, and single tree damage amounts to 18 565 cubic metres per year.

3) Unsalvaged wildfire losses:
Wildfire losses were based on a 10-year average from 1989 through 1998. The Lawless Creek Wildfire of 1998 is included in the total wildfire losses, but the extent of damage has been estimated based upon the salvage operations that are still in progress.

A.4.5 Silviculture and regeneration activities

The silviculture program guides the mix of treatments to be carried out in the Merritt TSA. It is assumed that basic silviculture is undertaken on all sites, plus incremental silviculture on some sites. Table A-21. shows the proportion of each analysis unit to be treated under each silviculture regime and the expected average regeneration delay.

Existing stands older than 25 years were assigned to VDYP curves initially, then assigned to TIPSY managed stand yield curves following their first harvest in the simulation. For example, a stand currently in AU 3 would regenerate to AU 103 following harvest, as indicated below in Table A-21. Growth in recent plantations (those less than or equal to 25 years as of 1999) and future stands was projected using managed stand yield tables (MSYTs) produced using the B.C. Forest Service table interpolation program for stand yields (TIPSY) growth and yield model. For example, a 10 year old fir / wet site stand on a high-quality site would be assigned to AU 103.

A.4 Forest Management Assumptions

Table A-21. Regenerated stand assumptions by analysis unit

							Regenerated species			Operational adjustment factors	
Source AUs	**Regen AU**	**Leading species**	**Site class (old)**	**Regen delay (yrs)[a]**	**Method / type**	**%**	**Species**	**Spp. %**	**Stems / ha**	**OAF 1**	**OAF 2**
3&4	103	Fir / Wet	Good / medium (GM)	2	Plant	100	Fd Pl Sx	5 79 16	1400	15	5
5&6	105	Fir / Wet	Poor (P)	2	Plant	100	Fd Pl Sx	5 79 16	1400	15	5
7&8	107	Pine / Fir	GM	3	Plant	100	Pl Sx Fd	90 5 5	1300	15	5
9&10	109	Pine / Fir	P	3	Plant	100	Pl Sx Fd	90 5 5	1300	15	5
11&12	111	Pine / Spruce	GM	2	Plant	100	Pl Sx	75 25	1400	15	5
13&14	113	Pine / Spruce	P	3	Plant	100	Pl Sx	75 25	1400	15	5
15&16	115	Pine	GM	2	Plant	100	Pl Sx	90 10	1300	15	5
17&18	117	Pine	P	2	Plant	100	Pl Sx	90 10	1300	15	5
19&20	119	Balsam / Hemlock	GM	3	Plant	100	Sx Pl	80 20	1300	15	5
21&22	121	Balsam / Hemlock	P	3	Plant	100	Sx Pl	60 40	1300	15	5
23&24	123	Spruce / Western white pine / Cedar	GM	2	Plant	100	Sx Pl	53 47	1400	15	5
25&26	125	Spruce / Western white pine / Cedar	P	2	Plant	100	Sx Pl	53 47	1400	15	5
27&28	127	Pine	P	4	Plant	100	Pl Sx	90 10	1300	15	5

Growth of selection analysis units (AUs 1 and 2) is projected using the Variable Density Yield Prediction (VDYP) growth and yield model. An OAF1 of 25% is used to limit the volume harvested in a given entry to 25% of the total volume at a given age. Once stands are harvested, they are regenerated back onto the original yield curve, but assigned an age of 90 years (30 years below the minimum harvestable age for AUs 1 and 2). These stands must then grow an additional 30 years before they are eligible for harvest. Once they are harvested, another 25% of the total stand volume is taken. This harvest pattern is used throughout the planning horizon.

A.4 Forest Management Assumptions

Data source and comments:

Values in Table A-21. were determined based on major licensee silviculture information system (MLSIS) reports and current performance as estimated by Merritt Forest District staff. Regeneration delay was increased in some pine analysis units to account for a proportion of natural regeneration. The average age of planting stock is estimated to be one year.

Operational adjustment factors (OAFs) were applied to all managed stand yield curves to account for natural spatial variation (OAF1), and decay, waste and breakage (OAF2), respectively. OAF 1 is a constant percentage reduction to account for small stocking gaps. OAF 2 accounts for losses that increase with age. The value of OAF 2 increases from zero and passes through 5% when the stand is 100 years old.

For sensitivity analysis, information on the proportion of planting stock that is class A (genetically improved) was compiled to allow assessment of the potential timber supply implications of planting these higher yield trees.

A.4.6 Backlog not satisfactorily restocked areas (NSR)

Not satisfactorily restocked (NSR) areas consist of current NSR and backlog NSR, as identified by type identity 4 or 9 in the inventory file. The data for backlog NSR was derived from the Integrated Silviculture Information System (ISIS) and the Major Licensee Silviculture Information System (MLSIS), excluding woodlots. These records indicated a total of 306 hectares of backlog NSR in the TSA, and 8500 hectares of current NSR. The current NSR estimate reflects approximately 2 years of current harvested area that has not yet been planted or naturally regenerated to stocking standards.

NSR area estimates reported by the ISIS database and district staff observations did not match with the amount of NSR indicated on the inventory file (22 029 hectares of the timber harvesting land base, excluding any NSR areas that fall within the Lawless Creek fire, discussed below). Therefore, steps were taken to 'update' the NSR records on the inventory file, with assistance from Merritt forest district staff, as described below. All NSR records remained within the timber harvesting land base.

Of the 22 029 hectares of NSR areas on the inventory file, 1883 hectares fall within selection management areas. These 'NSR' areas should not necessarily be considered the same as clearcut management NSR areas since most of these areas (1789 hectares) have been selectively harvested and the resulting stand density is lower than required for recently harvested clearcut areas that are regenerating. In reality, many of these stands have had their 'first entry' selection harvest, and the remaining timber is at some stage of nearing readiness for the next selection harvest. Therefore, the following approach was used to address NSR areas under selection management. For stands with an associated activity year, the age for these stands was established as the time since the last activity (e.g., logging) occurred. Therefore, a selection stand with an activity year of 1970 would have been assigned a new age of 29 years (1999-1970). The newly assigned ages for these stands ranged from 2 years to 44 years. For the remaining selection harvest NSR that either had no associated activity or record of age (93 hectares of the timber harvesting land base), the age was set to 0.

For the NSR stands that occur in areas not managed as selection stands (20 146 hectares), a similar approach was followed. If any past silvicultural activity was associated with the NSR stand, a new age was assigned to that stand based on the number of years since that activity had occurred. Therefore, the new ages for these stands would range from 0 years to 61 years. Most of these non-selection NSR stands (16 042 hectares) did have some level of activity associated with them. If there was no activity associated with these stands, the age associated with these stands was left as it was on the inventory file (ranging from 0 years to 71 years). Clearcut NSR stands were assigned to managed stand yield curves only if the past activity included logging, juvenile spacing, mechanical scarification, or brushing and weeding and if a silvicultural opening number had been assigned to the harvested area. Otherwise, these stands were assigned to VDYP yield curves.

A.4.7 Lawless Creek wildfire

The 1998 Lawless Creek wildfire of 1998 destroyed extensive areas of previously established plantations, some of which attained free-growing status, or were still under obligations to achieve free-growing status. Additional mature stands were also destroyed by the fire. The loss of both the young plantations and older stands has not yet been recorded in the inventory system because the fire was so recent. Therefore, the inventory file used in this analysis was adjusted to account for both the loss of mature timber and plantations.

According to Merritt Forest District records, there were approximately 2256 hectares of young plantations (stands less than 30 years old) in the area affected by the Lawless Creek wildfire. These areas were reassigned an age of –2 years. In other words, they were assumed to be regenerated to managed stand yield curves 2 years into the planning horizon in the analysis. All of these stands were assigned to either AU 107 or AU 109, depending on the original site quality.

Immature stands that were consumed by the fire (those between the ages of 30 and 80 years on the inventory file) covered approximately 1554 hectares, and were assumed to be 0 years of age at the start of the planning horizon. These areas were assumed to regenerate to their original unmanaged stand yield curves (VDYP curves) since it was unlikely that they would be managed.

Mature stands (those greater than 80 years of age) covered approximately 4180 hectares of the Lawless Creek wildfire area. Like the young plantations, these areas were assumed to be re-planted within the first 2 years of the planning horizon. Therefore, these stands were assigned an age of –2 years on the inventory file. They were assigned the managed stand yield curves that correspond with the existing stand AUs attributed to them on the inventory file.

A.4.8 Reductions to reflect volume retention in cutblocks

A.4.8.1 Wildlife trees

It was assumed that single trees retained for stand-level biodiversity would not be harvested in the future, and therefore these trees have been modelled as volume reductions (that is, adjustments to the yield estimates). To account for the retention of single trees within cutblocks, stand volumes were reduced by 2% (1.93% rounded up). This percentage reduction is based on current retention levels as reflected in silviculture prescriptions, guidelines specified in the *Merritt Forest District Policy*, and assumptions about contributions of non-harvestable areas to wildlife trees, as outlined above in Section A.3.13, "Wildlife tree patches." The reduction percentage is applied in the analysis, through operation adjustment factor (OAF) type 1, to all stands except those that are harvested under a selection management regime.

A.4.8.2 Silvicultural systems with fir reserves

In the Merritt TSA, a number of Douglas-fir trees are retained when lodgepole pine stands are harvested to assist regeneration or achieve other silvicultural objectives. This single tree retention is in addition to retention for stand level biodiversity purposes. Because this volume is not harvested or otherwise accounted for in the analysis, the yield curves for AUs 7, 8, 9 and 10 have been directly reduced by 15 cubic metres per hectare to account for retained fir trees.

A.4.8.3 Volume exclusions for deciduous trees in coniferous stands

Deciduous species in a predominantly coniferous stand are not presently harvested in the Merritt TSA. As a result, all VDYP yield curves were reduced to account for the retention of deciduous species in coniferous stands. These deciduous volume reductions are in addition to the volume exclusions for stand-level biodiversity discussed above.

A.4.9 Forest cover requirements

As noted in Section 4.1, "Management zones, groups and multiple objectives," forest cover requirements were applied to model management for a number of objectives. The role of non-contributing forest (forest outside the timber harvesting land base) was considered for forest cover requirements related to all forest management objectives except for standard management. In the case of standard management, forest cover requirements apply only to the timber harvesting land base. Where forest cover requirements are expressed using a height criteria, the age at which regenerated stands achieve this height was estimated using *SiteTools batch 2.3*. Then the ages were averaged within the management unit used. (For example, the age at which all stands within the Bell Community Watershed reach 6.6 metres was averaged to arrive at the green-up age of 23 years).

A.4.9.1 Forest cover requirements — landscape-level biodiversity

Only old-seral guidelines for landscape-level biodiversity were modelled, consistent with the assumptions used in the February, 1996 *Forest Practices Code Timber Supply Analysis*. As biodiversity emphases have not yet been approved for landscape units in the Merritt TSA, an average old-seral prescription was applied to all landscape units. This average prescription was calculated assuming a distribution of area between biodiversity-emphases of 45% low-biodiversity, 45% intermediate-biodiversity and 10% high-biodiversity. The per cent area of old-seral forest to be maintained over time under each biodiversity emphasis is based on values from the *Forest Practices Code Landscape Unit Planning Guide* for each of the biogeoclimatic variants in the Merritt TSA. In addition, old-seral targets for the low emphasis portion of the old-seral constraint have been reduced to one-third the *Planning Guide* value for the first rotation (0 to 80 years), two-thirds of the target for the second rotation (81 to 160 years), and the full target value for the remainder of the planning horizon (161 years onward). The final old-seral requirements calculated using this method for each landscape unit/variant combination are shown in Table A-22. in rows labelled 'Blended'.

A.4 Forest Management Assumptions

Table A-22. Old seral requirements by natural disturbance type (NDT)

		Old-seral stage			
		Minimum retention area (%)			
NDT	Biodiversity emphasis	Now	81 years	161 years	Minimum age (years)
2	Low	3	6	9	250
	Medium	9	9	9	250
	High	13	13	13	250
	Blended	**6.7**	**8.1**	**9.4**	**250**
3	Low	4.7	9.4	14	140
	Medium	14	14	14	140
	High	21	21	21	140
	Blended	**10.5**	**12.6**	**14.7**	**140**
4	Low	4.3	8.7	13	250
	Medium	13	13	13	250
	High	19	19	19	250
	Blended	**9.7**	**11.7**	**13.6**	**250**

As described above, these blended forest cover requirements are applied within each landscape unit/variant combination within the TSA. Note that NDTs areas except ESSFmwp assigned old-seral requirements as NDT 3. ESSFmwp areas were treated as ESSFmw (NDT2). Table A-23. shows the biogeoclimatic variants occurring within the Merritt TSA productive forest land base.

A.4 Forest Management Assumptions

Table A-23. Biogeoclimatic variants / natural disturbance types (NDTs)

NDT	Subzone/variant	NDT	Subzone/variant
2	CWHms1	4	IDFxh1a
2	ESSFmw	4	IDFxh2
3	ESSFdc2	4	IDFxh2a
3	ESSFxc	1	MHmm2
3	MSdm2	4	PPxh2
3	MSxk	4	BGxh2
3	MSunk[a]	4	BGxw1
4	IDFdk1	5	ATp
4	IDFdk1a	5	ESSFdcp
4	IDFdk2	5	ESSFmwp
4	IDFxh1	5	ESSFxcp

(a) MSunk denotes that the variant is unknown. The variant was assumed to be NDT 3.

As noted above, biodiversity emphasis options within the TSA had not been finalized when the analysis was initiated. To assess the timber supply implications of the draft biodiversity emphasis options, sensitivity analysis was performed in which draft biodiversity emphasis options were applied within landscape units, rather than the weighted or 'blended' forest cover requirements. The draft biodiversity emphasis options for landscape units in the Merritt TSA that were used in the various sensitivity analyses around landscape-level biodiversity are described in Table A-24., below.

A.4 Forest Management Assumptions

Table A-24. Draft landscape units and draft biodiversity emphases

Landscape unit	BEC	Draft Emphasis
Allison-Missezula	ESSFdc2, MSdm2, MSxk	Low
Allison-Missezula	IDFdk1, IDFdk2, IDFxh1	Intermediate
Allison-Missezula	IDFxh1a	Grasslands[a]
Coldwater	CWHms1, ESSFdc2, MSdm2, MSunk, MSxk	Low
Coldwater	ATp, ESSFdcp, ESSFmwp, ESSFmw, IDFdk1, IDFdk2, IDFxh1, IDFxh2, PPxh2	Intermediate
Coldwater	BGxw1, IDFdk1a, IDFxh2a	Grasslands[a]
Guichon	ESSFxc, MSdm2, MSxk	Low
Guichon	IDFdk1, IDFxh2, PPxh2	Intermediate
Guichon	BGxw1, IDFxh2a	Grasslands[a]
Hayes	ESSFxc, MSdm2, MSxk	Low
Hayes	IDFdk1, IDFdk2, IDFxh1	Intermediate
Hayes	IDFxh1a	Grasslands[a]
Lower Nicola River	ESSFdc2, ESSFxc, IDFdk1, IDFdk2, IDFxh1, IDFxh2, MSdm2, MSxk, PPxh2, ESSFdcp	High
Lower Nicola River	BGxh2	Grasslands[a]
McNulty	ESSFxcp, ESSFxc, MSxk	Low
McNulty	IDFdk1, IDFxh1	Intermediate
McNulty	IDFxh1a	Grasslands[a]
Nicola Lake	ESSFxc, MSxk	Low
Nicola Lake	IDFdk1, IDFxh2, PPxh2	Intermediate
Nicola Lake	BGxw1, IDFdk1a, IDFxh2a	Grasslands[a]
Otter	ESSFdc2, MSdm2, MSxk, ESSFdcp	Low
Otter	IDFdk1, IDFdk2	Intermediate
Quilchena	ESSFxc, MSxk	Low
Quilchena	IDFdk1, IDFxh2, PPxh2	Intermediate
Quilchena	BGxw1, IDFdk1a, IDFxh2a	Grasslands[a]
Similkameen	ATp, ESSFdcp, ESSFxcp, ESSFdc2, ESSFmw, ESSFxc, MSdm2,	Low
Similkameen	IDFdk1, IDFdk2, IDFxh1	Intermediate
Similkameen	IDFxh1a	Grasslands[a]
Smith-Willis	ESSFxc, MSdm2, MSxk, ATp	Low
Smith-Willis	IDFdk1, IDFdk2, IDFxh1	Intermediate
Smith-Willis	IDFdk1a, IDFxh1a	Grasslands[a]
Spius	ESSFdc2, IDFdk1, IDFdk2, IDFxh1, IDFxh2, MSdm2, Msunk, PPxh2, ATp, ESSFdcp, ESSFmwp	Intermediate
Spius	CWHms1, ESSFmw	High
Tulameen	ATp, ESSFdcp, ESSFmwp,	Low
Tulameen	CWHms1, ESSFdc2, ESSFmw, IDFdk2, IDFxh1, MHmm2, MSdm2, Msunk	Intermediate
Tulameen	IDFxh1a	Grasslands[a]
Upper Nicola River	MSxk	Low
Upper Nicola River	IDFdk1, IDFdk2	Intermediate
Upper Nicola River	BGxw1, IDFdk1a, IDFxh2a	Grasslands[a]

(a) Areas with a 'Grasslands' biodiversity emphasis did not have any old-seral requirements applied to them in the analysis. Instead, these areas were assumed to be harvested and then managed as grasslands, not as forested land, as discussed above in Section A.3.13, "Future land base reductions for conversion of grasslands."

A.4 Forest Management Assumptions

Data source and comments:

The percentages for old-forest seral stage retention are based on recommendations in the *Landscape Unit Planning Guide* and the *Biodiversity Guidebook*, in keeping with Deputy Minister, Chief Forester, and Timber Supply Branch direction. Rotation ages are as described within the *Landscape Unit Planning Guide*. Biodiversity forest cover requirements apply to all Crown forested land, both above and below the operability line. The forest not contributing to the timber harvesting land base within each landscape unit is assumed to age over the duration of the harvest forecast.

A.4.9.2 Forest cover requirements — community watersheds

In order to account for and approximate current management, a maximum of 20% of the gross (total) forested land base in community watersheds can be less than 6.6 metres in height. This height constraint was converted to an age estimate, and applied individually within each community watershed listed below in Table A-25. The forest cover constraint was applied to the total productive forest area, not just the timber harvesting land base.

Table A-25. Community watersheds

Watershed	Maximum % area younger than minimum tree age	Minimum tree age
Anderson	20	24
Bell	20	23
Brook	20	32
Dillard	20	24
Hackett	20	25
Kwinshatin	20	28
Lee	20	25
Skuagum	20	28
Trout	20	26

Note that the Thomas community watershed did not have forest cover requirements applied to it because none of the portion of this watershed in the Merritt TSA included productive forest area.

It is assumed that selection management satisfies mature cover and green-up requirements for community watersheds, so where that silvicultural system is used, no additional forest cover requirements were applied.

A.4.9.3 Forest cover requirements — ungulate winter range

Ungulate winter range areas are managed to ensure sufficient thermal cover is maintained. As per the approved *Merritt TSA Ungulate Winter Range Strategy*, no more than 20% of the productive forested area may be less than 3 metres in height and at least 40% of the productive forested area must be at least 20 metres in height. Table A-26. shows the green-up ages corresponding to these heights. Note that winter range areas were modelled separately by landscape unit.

Table A-26. Forest cover requirements for ungulate winter range areas

Landscape unit / ungulate winter range area	Maximum % area younger than minimum tree age	Minimum tree age	Minimum % area older than mature cover age	Minimum mature cover age
Allison-Missezula	20	15	40	94
Coldwater	20	16	40	115
Guichon	20	16	40	100
Hayes	20	14	40	95
Lower Nicola River	20	16	40	138
McNulty	20	15	40	112
Nicola Lake	20	16	40	122
Otter	20	15	40	101
Quilchena	20	16	40	117
Similkameen	20	14	40	94
Smith-Willis	20	15	40	101
Spius	20	16	40	114
Tulameen	20	17	40	99
Upper Nicola River	20	14	40	83

As with community watersheds, it is assumed that selection management satisfies mature cover and green-up requirements for ungulate winter range, so where that silvicultural system is used, no additional forest cover requirements were applied.

A.4.9.4 Forest cover requirements — elk movement corridors

Based on historic and current performance, elk movement corridors are managed in a similar manner to ungulate winter ranges. In order to account for the management practices that occur within these corridors, no more than 20% of the productive forest area may be less than 3 metres in height and at least 40% of the productive forest area must be at least 20 metres in height. Since elk movement corridors are restricted to the Similkameen landscape unit, they were modelled as one contiguous area. For the purposes of the analysis, a 3-metre green-up height was estimated to take 16 years to achieve; a 20 metre mature cover height was estimated to take 97 years to achieve. As above, it is assumed that selection management satisfies mature cover and green-up requirements for elk movement corridors, so where that silvicultural system is used, no additional forest cover requirements were applied.

A.4.9.5 Forest cover requirements — visually sensitive areas

Visually sensitive areas within the Merritt TSA are managed within the visual zones along major travel corridors and around A, B, and C class lakes. Forest cover requirements for these areas are modelled as described in Table A-27. The forest cover requirements are applied not just to the entire productive forest land base, but also to a small portion of the non-productive forested land base, as described above in Section A.3.2, "Land classified as non-forest or non-productive forest."

Constraints for visually sensitive areas have been determined for each visually sensitive polygon based on methods described within the *Procedures for Factoring Visual Resources into Timber Supply Analyses* (MoF 1998, report REC-029) modified further by Merritt Forest District staff in consultation with the Regional Landscape Management Forester. The forest cover requirements are the mid-point of the per cent removal range for the VQO polygon, and applied to each visually sensitive polygon individually to most closely approximate actual visual considerations.

Table A-27. Forest cover requirements for visually sensitive areas

	Maximum % younger than green-up height								
	Low VAC			Intermediate VAC			High VAC		
Visual quality objective	Green-up height (m)	Green-up age	Maximum % removal	Green-up height (m)	Green-up age	Maximum % removal	Green-up height (m)	Green-up age	% removal mid-point
Preservation	5	23	3	4	19	4	3	17	5
Retention	5	23	5	4	19	7.5	3	17	10
Partial retention	5	23	10	4	19	15	3	17	20
Modification	5	23	17.5	4	19	22.5	3	17	27.5

Data source and comments:

The visually effective green-up (VEG) heights were determined using field data gathered from plots established along major highway corridors in the Merritt TSA.

VQO polygons that were very small (less than 10 hectares) were modelled as part of the standard management zone (described below) because Merritt Forest District staff indicated that these stands would likely be harvested all at once, rather than in small portions (e.g., 5% every 23 years). In addition, the Merritt Forest District staff indicated that the selection harvest regimes used in the Merritt TSA meet all visual quality objectives, no forest cover requirements were applied to VQO areas falling within selection management areas.

A.4.9.6 Forest cover requirements — standard resource management areas

Standard management involves a 3-pass harvesting sequence, requiring no more than 33% of the timber harvesting land base be less than 3 metres in height at any time. The forest cover requirements for these management areas are applied to the timber harvesting land base only, and are applied within each landscape unit separately. Table A-28. describes the forest cover requirements applied within each standard management zone / landscape unit area within the Merritt TSA.

A.4 Forest Management Assumptions

Table A-28. Forest cover requirements for standard resource management areas

Landscape unit / standard management zone	Maximum % area younger than minimum tree age	Minimum tree age
Allison-Missezula	33	14
Coldwater	33	17
Guichon	33	16
Hayes	33	15
Lower Nicola River	33	17
McNulty	33	16
Nicola Lake	33	15
Otter	33	16
Quilchena	33	15
Similkameen	33	16
Smith-Willis	33	16
Spius	33	19
Tulameen	33	18
Upper Nicola River	33	15

A.4.10 Volume estimates for existing stands

The variable density yield prediction (VDYP) model, Version 6.5a developed and supported by the B.C. Ministry of Forests, Resources Inventory Branch, was used to estimate timber volumes for existing natural stands. Table A-29. shows the volume estimates by analysis unit for existing natural stands. See Section A.2.2 for a complete description of analysis units.

A.4 Forest Management Assumptions

Table A-29. Projected volumes for natural stands using VDYP

	Species — site													
	Fd/Py dry		Fd wet GM		Fd wet P		Pl/Fd GM		Pl/Fd P		Pl/Sx GM		Pl/Sx P	
	Selection		young	old	young	old	young	old	young	old	young	old	young	old
	Analysis unit													
Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	1	1	0	0	0	0	0	0	8	11	1	1
40	3	4	20	16	0	0	27	21	0	0	47	55	13	6
50	12	15	56	51	8	11	66	59	12	7	92	102	42	24
60	28	32	90	84	26	31	101	93	37	32	134	145	74	49
70	45	50	123	116	45	52	133	124	60	55	171	183	105	78
80	62	69	155	146	64	72	161	151	81	76	203	216	134	106
90	79	86	185	174	82	92	187	176	101	96	232	246	160	133
100	95	103	213	201	99	110	211	199	119	114	259	273	184	159
110	111	120	240	226	116	128	232	219	136	130	282	297	207	184
120	125	134	263	248	130	144	252	239	151	146	304	319	227	206
130	138	148	285	269	144	159	271	257	166	160	324	340	247	228
140	150	161	304	287	156	172	285	271	178	172	339	355	261	246
150	160	172	321	303	167	184	297	283	188	183	351	367	273	261
160	170	182	336	318	177	195	307	293	196	192	360	376	283	274
170	178	191	349	330	185	204	315	301	203	199	367	383	290	285
180	187	199	361	342	193	214	321	308	209	205	371	387	295	293
190	195	208	372	354	201	222	325	312	213	210	372	389	298	300
200	202	215	383	365	208	231	331	319	218	216	376	393	302	307
210	209	223	394	375	215	239	336	324	223	222	380	397	307	315
220	216	230	403	384	222	247	342	330	228	227	384	401	311	322
230	223	236	413	393	228	254	347	336	232	232	387	404	315	328
240	229	243	421	401	234	261	352	341	236	237	391	408	319	334
250	234	248	429	409	240	267	357	346	241	242	394	411	323	340
260	235	249	430	410	241	268	358	347	241	242	396	413	325	344
270	235	249	431	411	242	269	358	347	242	243	399	416	328	348
280	235	249	432	412	242	270	359	348	243	244	401	418	330	352
290	235	250	433	413	243	270	360	349	243	244	402	420	332	356
300	236	250	434	414	243	271	361	350	244	244	404	422	334	359
310	236	250	434	414	244	271	361	350	244	245	406	423	336	362
320	236	250	435	415	244	272	362	351	245	245	407	425	337	365
330	236	250	436	415	245	272	362	351	245	245	408	426	338	367
340	236	251	436	416	245	273	363	351	245	246	409	427	340	369
350	236	251	437	416	245	273	363	352	245	246	410	428	341	372

(continued)

Table A-29. ***Projected volumes for natural stands using VDYP (concluded)***

	Species — site													
	Pine GM		Pine P		Bl/Hw GM		Bl/Hw P		Sx/Pw/Cw GM		Sx/Pw/Cw P		Smallwood Pine	
	Young	old	young	old	young	old	young	old	young	old	young	old	young	old
	Analysis unit													
Age	15	16	17	18	19	20	21	22	23	24	25	26	27	28
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	6	6	0	0	2	2	0	0	1	0	0	0	0	0
40	51	52	14	8	21	15	1	1	9	10	0	1	3	0
50	96	97	48	38	55	47	13	8	46	44	3	2	23	3
60	136	137	82	70	92	89	32	23	98	96	18	12	48	21
70	173	173	113	100	129	130	60	47	145	143	49	33	73	44
80	205	205	142	127	160	164	83	68	186	184	84	60	96	65
90	236	235	168	153	188	193	104	88	222	220	115	87	118	86
100	264	263	194	177	212	220	122	105	254	251	144	114	139	105
110	290	289	217	200	235	244	140	121	282	277	170	139	159	124
120	314	313	239	221	256	265	156	136	306	300	193	162	177	141
130	337	336	261	242	279	288	173	152	328	321	215	184	195	158
140	353	351	275	256	299	309	189	167	346	340	235	204	207	170
150	364	362	286	267	318	329	205	181	363	356	253	222	217	180
160	373	371	294	275	336	347	219	194	377	370	268	239	225	188
170	377	375	299	281	353	364	233	207	389	382	283	254	230	194
180	379	377	301	283	368	380	246	219	399	393	295	268	232	197
190	377	375	300	282	383	395	259	230	409	402	307	280	232	198
200	379	377	303	285	397	409	271	241	417	411	317	292	235	201
210	381	380	305	288	410	423	283	252	425	419	327	303	238	204
220	384	383	308	291	424	436	294	262	432	426	336	313	241	207
230	386	385	311	294	436	448	305	272	438	432	345	322	243	210
240	389	388	313	296	448	460	315	281	444	438	352	331	246	213
250	391	390	316	299	460	471	325	290	450	443	359	338	248	215
260	393	393	318	301	462	475	328	293	453	447	364	344	250	217
270	395	395	319	303	464	479	330	295	456	450	368	349	251	219
280	397	397	321	304	467	483	332	298	458	452	372	354	253	221
290	399	398	323	306	468	486	334	300	461	454	375	358	254	222
300	401	400	324	307	470	489	336	302	463	456	378	362	255	223
310	402	402	325	309	472	492	338	304	465	458	381	366	256	224
320	403	403	326	310	474	495	340	306	466	459	384	369	257	225
330	404	404	327	311	475	498	342	307	468	460	386	372	258	226
340	405	405	328	311	477	500	343	309	469	462	388	375	258	226
350	406	406	328	312	478	503	345	310	470	462	390	377	259	227

A.4 Forest Management Assumptions

A.4.11 Volume estimates for regenerated stands

WinTIPSY (Windows™ version of the Table Interpolation Program for Stand Yields) version 2.1 alpha D, supported by the B.C. Ministry of Forests, Research Branch, was used to estimate growth and yield for existing and future managed stands. Existing managed stands were assumed to be all stands with an age of 25 years or less as of 1999. The area-weighted site index for each analysis unit along with the regeneration assumptions in Table A-21. were used as inputs to TIPSY.

Table A-30. displays the volume tables for managed stands. These volume tables are generated from TIPSY for ages where TIPSY data exists, and estimated for ages beyond the TIPSY data set. Volumes are assumed to remain constant after 350 years of age.

A.4 Forest Management Assumptions

Table A-30. Projected volumes for regenerated stands using TIPSY

	Species – site												
	Fd wet GM	Fd wet P	Pl/Fd GM	Pl/Fd P	Pl/Sx GM	Pl/Sx P	Pl GM	Pl P	Bl/ Hw GM	Bl/ Hw P	Sx/ Pw/ Cw GM	Sx/ Pw/ Cw/ P	Smallwood pine
	Analysis unit												
Age	**103**	**105**	**107**	**109**	**111**	**113**	**115**	**117**	**119**	**121**	**123**	**125**	**127**
0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1	0	1	0	1	0	0	0	0	0	0	0	0
30	25	2	22	2	22	1	20	2	0	0	5	0	0
40	77	17	76	17	70	12	71	20	7	0	36	1	7
50	137	47	132	45	130	35	126	52	31	2	92	5	26
60	192	82	182	80	185	62	177	89	83	9	159	16	50
70	237	118	226	112	234	98	222	123	145	26	221	37	79
80	277	151	261	142	275	130	258	155	202	52	275	71	105
90	309	180	292	167	312	161	289	182	253	84	324	106	131
100	337	205	315	189	340	188	314	206	305	118	363	141	153
110	356	225	334	208	362	210	331	225	346	152	389	173	173
120	373	243	349	224	382	231	349	243	375	180	409	201	188
130	391	261	364	238	393	249	361	259	399	206	429	225	202
140	401	277	378	250	408	266	374	271	418	231	444	250	216
150	412	291	388	263	416	281	385	284	433	254	454	274	228
160	421	301	396	272	425	292	395	295	446	277	463	293	238
170	429	309	402	280	431	300	400	301	457	295	472	308	247
180	433	314	408	287	437	311	405	307	463	309	476	320	253
190	439	319	413	292	441	319	411	310	472	319	475	331	261
200	443	324	419	295	445	322	413	314	478	331	474	339	266
210	444	328	421	299	447	326	418	320	481	338	474	345	272
220	445	330	426	302	446	330	420	323	479	346	472	353	275
230	441	335	429	304	444	331	422	325	478	355	471	357	278
240	441	338	430	306	443	336	423	328	478	360	470	364	283
250	440	339	426	309	440	337	426	329	478	364	469	364	287
260	441	342	423	310	441	337	423	329	477	368	470	367	288
270	439	340	421	311	438	338	419	330	475	373	469	369	286
280	439	338	420	312	437	342	412	328	474	376	466	371	286
290	437	337	416	317	435	343	410	325	472	376	464	370	286
300	437	337	416	317	435	343	410	325	472	376	464	370	286
310	437	337	416	317	435	343	410	325	472	376	464	370	286
320	437	337	416	317	435	343	410	325	472	376	464	370	286
330	437	337	416	317	435	343	410	325	472	376	464	370	286
340	437	337	416	317	435	343	410	325	472	376	464	370	286
350	437	337	416	317	435	343	410	325	472	376	464	370	286

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis portion of this report identifies employment and income impacts, changes in government revenues, and community impacts as a result of changes in the TSA's harvest levels over time. Some of the assumptions used in this report are as follows:

- **Employment multiplier** — employment multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. The calculation of employment multipliers is based on analytical assumptions and data collected at a specific time period. The multipliers reflect industry and employment conditions at that time and may not accurately reflect industry and employment conditions in the future.
- **Employment coefficient** — employment coefficients are ratios of person-years of employment per 1000 cubic metres of timber harvested. These ratios are used to estimate employment levels associated with alternative harvest rates. This method of analysis assumes that the industry structure will be the same in the future as it is today. While reasonably accurate in the short term, employment coefficients may change in the future due to changes in market conditions, product mix or production technologies.
- **Timing of impacts** — employment impacts are shown to occur simultaneously with a change in the harvest level. While this assumption is reasonably accurate for the harvesting sub-sector, employment estimates for the silviculture and timber processing sub-sectors may not be as coincidental. As well, indirect and induced impacts tend to occur over a longer period, as levels of business and consumer spending adjust to changes in harvest levels.
- **Operating thresholds of mills** — it is unlikely that impacts on timber processing employment due to changes in harvest levels will be in direct proportion to the harvest changes (i.e., a 10% change in harvest may not lead to a 10% change in timber processing employment). Impacts on timber processing employment are more likely to occur step-wise related to operating thresholds of mills. For example, if a mill's timber supply is reduced, its operating threshold is reached when the decrease in timber supply causes it to lay off a shift of workers or to close the mill, either temporarily or permanently. Conversely, if the timber supply to the mill is increased, a processing threshold is reached when the mill has to decide whether to add another shift of workers or new capacity to process the increase in timber supply. In both cases, the per cent change in employment in the mill would probably differ from the per cent change in the timber processed. Because mills have many different operating configurations, accurately predicting an individual mill's operating threshold is impossible. As a result, impact figures pertaining to employment in timber processing are best interpreted as size of change rather than as precise changes in employment levels.
- **Government expenditures** — provincial government expenditures are more related to government policy and population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite changes to the harvest level and subsequent changes in government revenues from the forestry sector. However, provincial government expenditures would likely change if a community's population significantly changes. This would amplify the community impacts of losses or gains in forestry sector jobs.
- **Proportional harvest reductions** — harvest reductions are assumed to be proportionately distributed among all licensees and all forms of tenure within the TSA.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the TSA. Other general economic data are from BC STATS, the Ministry of Finance and Corporate Relations, Statistics Canada and local communities. Estimates of taxes paid by the forest industry are from PriceWaterhouseCoopers.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment.

To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1) harvesting;
2) silviculture; and
3) timber processing.

Employment and income impacts were estimated in several steps. The first step was to assess current activity in each of the three sub-sectors. Then, indirect and induced employment and employment income impacts were estimated, using data from Ministry of Finance and Corporate Relations (1996) and Statistics Canada. Next, employment coefficients were calculated and then applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes were also calculated, using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log salvage, planning and administration functions and log transportation. The employment multipliers used in this analysis define activities such as road building or maintenance work as indirect employment rather than direct employment because the forestry sector and other basic sectors purchase these services.

Data on employment, place of residence and timber flows were obtained from responses to questionnaires that were sent to licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of residents versus non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1) TSA direct employment in harvesting consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and
2) Provincial direct employment in harvesting consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting-related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

B.2 Economic Impact Analysis Methodology

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part time during the year. Because of this, information on silviculture employment was converted into equivalent full-time person-years of employment. Respondents were also asked to estimate the percentage of their silviculture employees who resided within the TSA and outside the TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber supply is from the harvest of the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest. Employment figures were also adjusted to reflect the residences of workers (i.e., those who lived within the TSA and those who lived outside the TSA). Employment in timber processing that is supported by chip by-products from milling operations was also similarly estimated.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employment in the forestry sector refers to those who provide goods and services to firms directly engaged in the basic forestry sector (for example, those who build or maintain road for log transport). Induced employment refers to those who provide the goods and services purchased by employees who are directly and indirectly engaged in the industry (for example, those who work in retail outlets). Indirect and induced employment figures were calculated using TSA and provincial employment multipliers developed by the Ministry of Finance and Corporate Relations.

Two sets of employment multipliers were calculated for this report: a migration multiplier and a no-migration multiplier. The migration multipliers assume that displaced workers will leave the region, reducing total income in the region by their full wage. The no-migration multipliers assume that displaced workers remain in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the degree of induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

The TSA and provincial employment multipliers used in the Merritt TSA analysis are shown in Table B-1.

Table B-1. Employment multipliers — Merritt TSA

Forestry sub-sector	Merritt TSA migration multiplier	Merritt TSA no-migration multiplier	Provincial (interior) migration multiplier	Provincial (interior) no-migration multiplier
Harvesting	1.33	1.21	2.14	1.80
Solid wood processing	1.38	1.23	2.29	1.93
Plywood	1.38	1.23	1.93	1.64
Pulp	1.62	1.46	3.02	2.48

Sources: Ministry of Finance and Corporate Relations. 1999. The 1996 Forest District Tables.

Ministry of Finance and Corporate Relations. 1996. A provincial impact estimation procedure for the British Columbia forestry sector.

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Based on Statistics Canada data, the weighted average annual pre-tax income (less benefits) for forestry sector workers in 1999 was:

- $46,956 for those working in logging and forestry services;
- $44,980 for those working in solid wood manufacturing; and
- $58,136 for those working in pulp and paper mills.

Those in indirect and induced occupations earned approximately $30,732. Income taxes were calculated based on marginal tax rates of 23-28% with one-third of the total income tax paid accruing to the province.

Employment estimates of alternate timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions in future years. Therefore, the employment estimates should be viewed as indicators of size of change rather than as precise estimates of changes in employment levels.

Provincial government revenues

Except for stumpage, royalty and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated (Table B-2.).

B.2 Economic Impact Analysis Methodology

Table B-2. Estimates of provincial government revenues — Merritt TSA

	Average annual revenue 1996–1999 ($ millions)	**Revenue ($ per '000s m^3)**
Stumpage and related payments[a]	30.3	21,300
Forest industry taxes[b]	10.6	7,450
Employee income tax[c]	9.7	6,800
Total	**50.6**	**35,550**

(a) Source: Ministry of Forests, Revenue Branch.

(b) Based on estimates by PriceWaterhouseCoopers. Includes taxes for logging, corporate income, corporate capital, sales, property and electricity.

(c) Estimated from Revenue Canada income tax rates and includes only the provincial share of income taxes paid.